SCIENTIFIC AMERICAN

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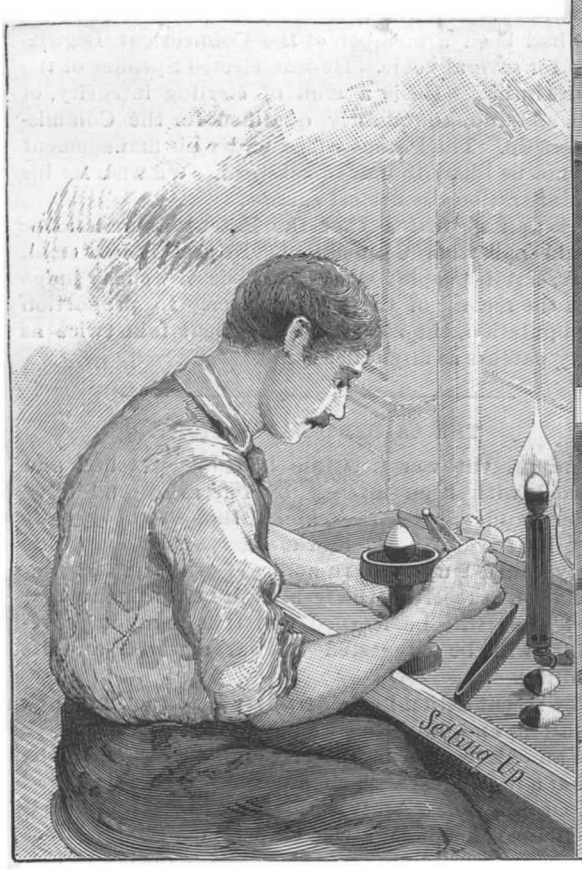
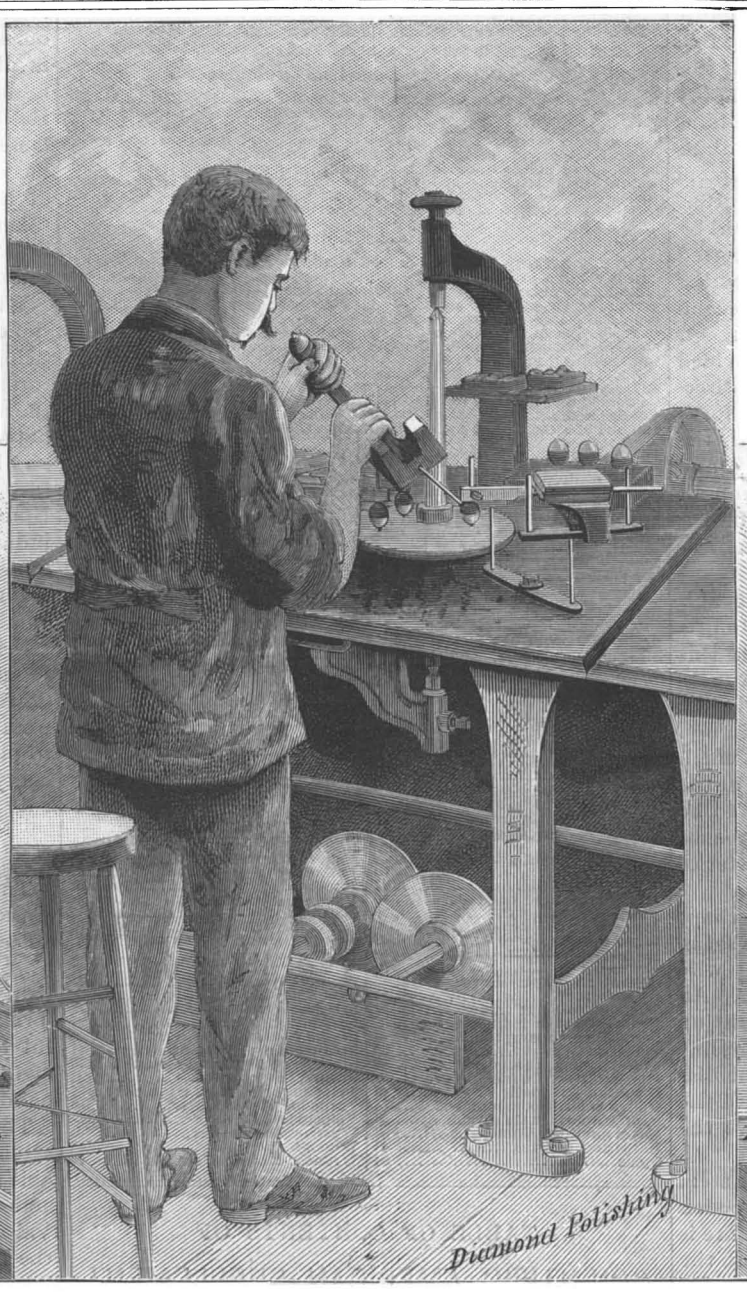
DIAMOND CUTTING BY HAND AND MACHINE.

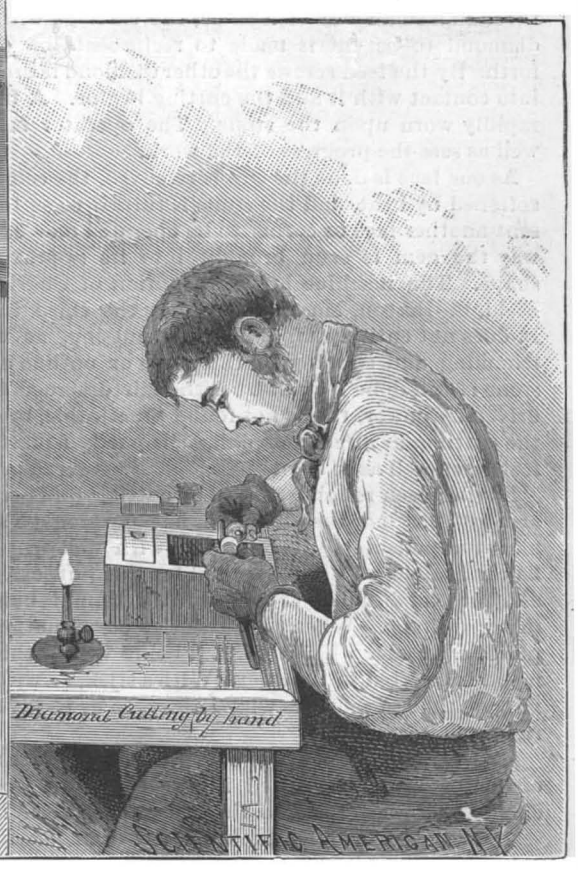
Modern diamond cutting is an art which for many generations was practically confined to one city, Amsterdam. In India the natives cut the gems, but they did not follow the rules of shape which have found acceptance with the Caucasian nations. Some twenty years ago the industry was introduced in this country. This was at about the time of the discovery of the South African diamond fields. Mr. I. Herrmann, a jeweler of this city, succeeded in finding among the Dutch who had immigrated to this country a number of diamond workers who from force of circumstances had abandoned their trade and had adopted other occupations.



CLEAVING.



POLISHING ON HORIZONTAL WHEEL.



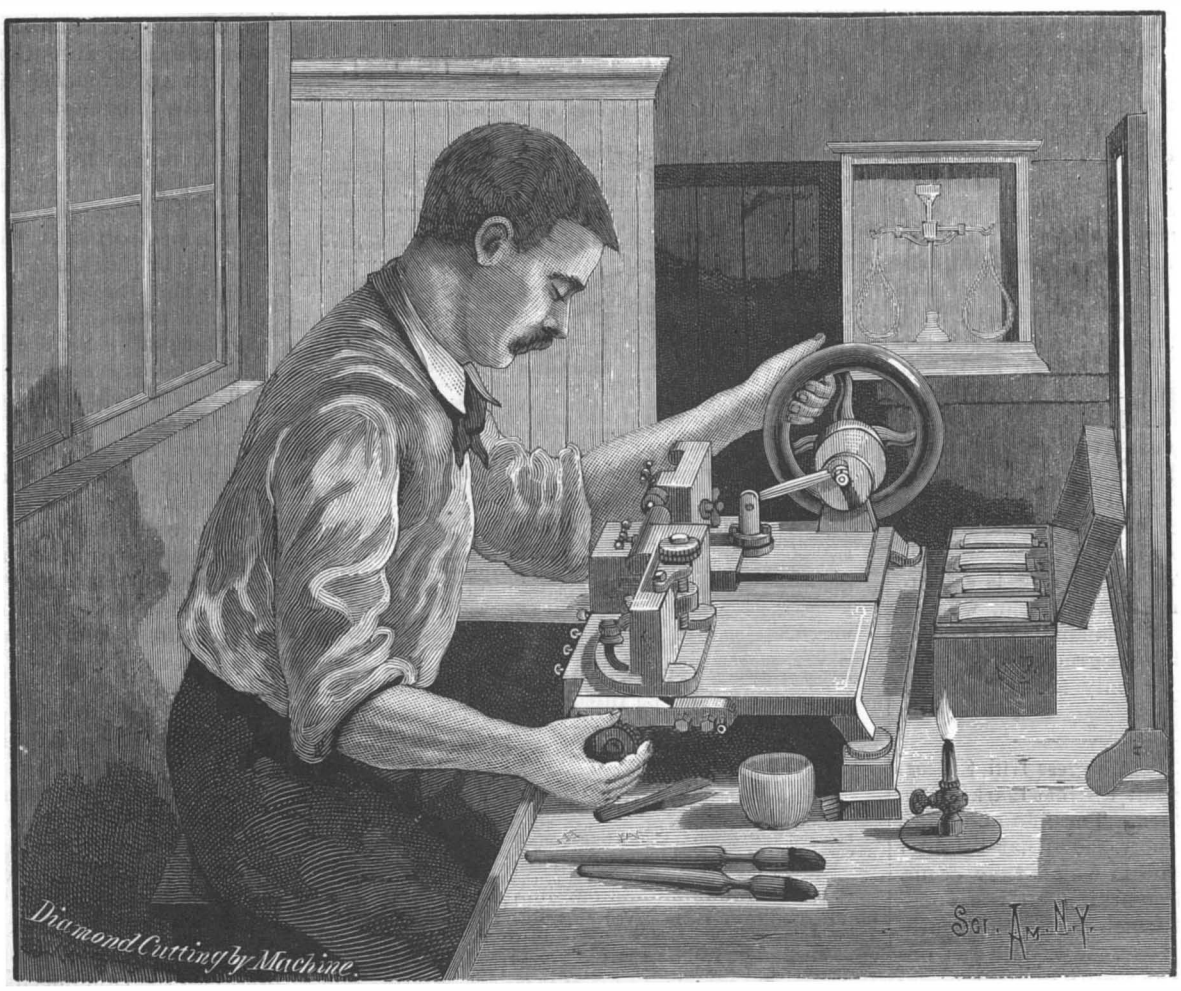
HAND CUTTING.

He opened a shop in this city, where much work was done.

The industry spread more or less, and is now firmly established in several places in the United States. The jewelry firm of Tiffany & Co., of this city, among others, have in operation a shop in which diamonds are cut and polished from the rough, and are recut when the original cutting as performed in Amsterdam or elsewhere has not left them of satisfactory brilliance. The work is in charge of the foreman, Mr. Geo. H. Hampton, to whom we are indebted for attentions shown in connection with this article.

The operations of shaping a diamond are three, and may be four, in number: cleaving, cutting, setting and polishing. Each operation is a trade by itself, and very few ever learn to do more than one or two of the four steps. Cleaving is often dispensed with; the other three are necessary. The favorite shape into which every stone of any value is worked is the brilliant. This consists approximately of two truncated pyramids placed base to base. The line dividing the two pyramids is called the girdle. The upper portion is the crown, with a flat face called the table on top. Below the girdle is the collet. If properly cut, this shape brings out the fullest possible brilliancy of the gem. So important is this quality, that it was deemed advisable to recut the Kohinoor diamond to develop its brilliancy, although many karats were lost in the operation.

Cleaving consists in splitting off pieces of a diamond. By inspection striations can be detected in the rough gem by which its cleavage plane is determined. The stone to be thus treated is mounted in cement upon the end of a wooden handle. Upon a second handle a sharp-edged fragment such as has been cleaved from another diamond is mounted. The diamond has a little notch made in it by the cleaver pressing and rubbing against it the edge of the fragment. This marks the place for starting the cleavage. A cutting box is used in making this notch. This is shown in the illustration in use for regular cutting. It is a small metal box from whose edge two brass pins or studs rise, against which the spindle-shaped handles are pressed in the cutting operation. The cleaver holds a handle in each hand, pressing them firmly against the pins and edges of the box. The ends carrying the diamonds project over the box. He then scratches or cuts a notch at the desired place. Next, placing the handle carrying the diamond to be cleaved on its end upon the table, he holds a blunt-edged knife of steel firmly upon the notch and gives the back of the knife a



THE FIELD DIAMOND CUTTING MACHINE.

DIAMOND CUTTING BY HAND AND MACHINE.

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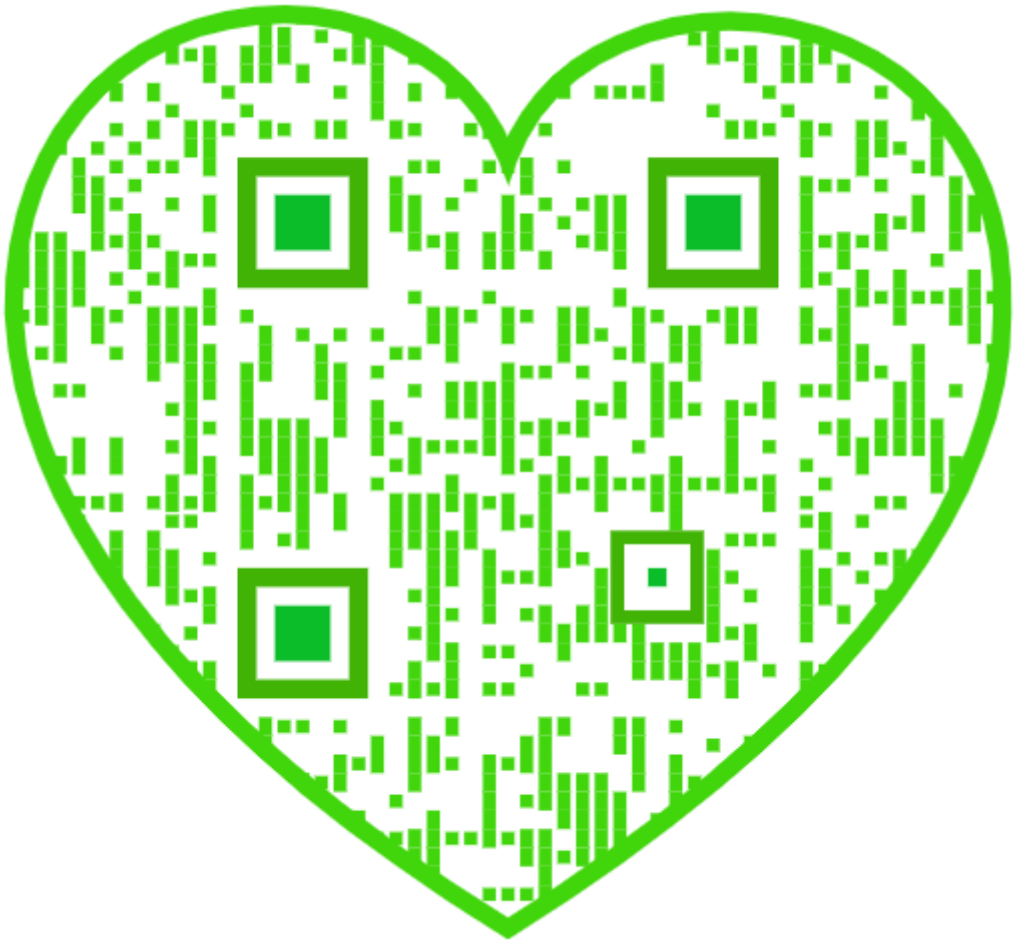

gentle tap with an iron rod. The piece at one blow splits off and leaves a bright face. Considerable skill and judgment are needed to perform this critical work, but it is by no means such a mystery as it has been represented to be.

The cutting operation is conducted with heavier handles over the cutting box just described. One diamond is rubbed against another, both cemented on the ends of handles, over the box, and the abrading goes on rapidly. Here a peculiar skill is needed to give the right stroke. Without it true cutting will not be effected. The left hand stone is the one which receives the final cutting; the right hand stone gets its first rough shaping only. The box has a movable receptacle below to receive the dust. A fine wire gauze screen is above it, to catch any cement which may fall.

A machine has been introduced for performing this work which is in constant operation in the Tiffany shop. It is essentially a planing machine. It contains a fixed adjustable abutment and a reciprocating abutment forming a species of slide rest. These correspond to the right and left hand handles of the hand cutter. The diamond receiving its final cutting is secured by cement in a cup with spindle, which spindle is inserted into a hole in the left hand carriage or reciprocating slide rest. The right hand abutment receives a second cup, with the cutting diamond held in it by cement. Quadrant adjustments and feed screws are provided for shifting the fixed abutment in any desired direction. By turning the hand wheel back and forth through a small arc of a circle, the carriage with the diamond to be cut is made to reciprocate back and forth. By the feed screws the other diamond is brought into contact with it and the cutting begins. A face is rapidly worn upon the stone. The operator feels as well as sees the progress of the work.

As one face is done the cup is removed, the cement is softened by heat, and the stone is turned so as to present another face or corner to be operated on. In this way the gem is soon brought into its approximate shape. The machine is the invention of Charles M. Field, of Boston, Mass., and is only the third in use. It does not entirely supplant hand cutting, as much trimming and shaping of the girdle or outline of the stone is still done by hand. Although designed to be driven by power, this is not found practicable, because the cutting, as already explained, is partly a matter of feeling as well as of sight.

Having been roughly shaped by cutting, and perhaps also by cleaving, the diamond has next to be set in alloy for polishing. A brass cup with a copper wire handle, called a "dopp," is used for this purpose. An alloy of lead and pewter is used to fill it and is built up in acorn shape. When of the consistency of putty, like plumber's solder when a joint is being wiped, the diamond is inserted in the apex. With a stick, or with the fingers, the hot metal is wiped away, so as to give the right exposure.

After cooling it goes to the polisher. The wire stem of the "dopp" is fastened in the end of a wooden clamp. The operative in the upper central figure is seen holding one and examining the diamond in the "dopp." The clamp is next placed on the table steadied by a couple of pins secured thereto. A horizontal disk of iron cut or scratched in approximately radial grooves is mounted in the center of the table, and rotates at a speed of 20,000 to 25,000 revolutions per minute. The speed is so high and the motion so steady that the disks seem motionless. As the clamp is placed on the table, the diamond at its end rests upon the disk. The latter is charged with olive oil and diamond dust from the cutting boxes. After a few seconds the polisher removes the clamp and examines the stone. By pushing the cup he bends the wire one way or the other, so as to get a proper bearing. One or two trials are made. When all is right some lead weights are placed upon the clamp and it is left to itself. The polishing, which is really cutting to a considerable extent, now goes on, and lasts for a variable time, according to the work to be done.

The polisher becomes very expert in seeing what is going on by inspecting the diamond, as well as in detecting by the feel of the clamp how the diamond is resting on the disk. Even the bending of the wire of the dopp requires considerable skill.

The modern system of diamond cutting is said to have originated in 1456, with Louis Bergnen, who established a regular guild of diamond cutters at Bruges in 1470. Since then the art gradually centered itself in Amsterdam, and now only is beginning to spread to other cities.

MR. A. STANLEY WILLIAMS, of Burgess Hill, Sussex, has discovered three delicate but distinct markings in the equatorial region of Saturn. The first and third of these are round bright spots, somewhat brighter than the white equatorial zone in which they occur. The second is a smaller dark marking on the equatorial edge of the shaded belt which forms the southern boundary of the white zone. Mr. Williams has obtained abundant proof of the reality of these markings, but points out that it requires patience and practice to see them readily.

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THE COMMISSIONERSHIP OF PATENTS.

The Hon. Charles E. Mitchell, who for the last two years has served as Commissioner of Patents, has resigned the office, and the Hon. William E. Simonds, of Connecticut, has been appointed to the position.

The retirement of Mr. Mitchell may almost be regarded as a calamity to the Patent Office. His administration has been highly successful, has given great satisfaction, and from beginning to end has been conducted with consummate ability. His rulings and decisions, always promptly given, have been distinguished for their judicial clearness and reliability. Fair and impartial hearing and consideration of both sides of the presented case has been his habit. Subject to a just regard for the public interests, he has administered the office for the benefit of inventors, for whose encouragement it was created. The progress of the Patent Office under Mr. Mitchell's guidance has been very marked. He has instituted many changes and reforms of most beneficial character. His superior administrative skill has enabled him to advance and improve the efficiency of the bureau; and in this flourishing condition he takes his leave, much to the regret of subordinates, practitioners, and all with whom he has had official relations.

William E. Simonds, the newly appointed Commissioner of Patents, is forty-nine years old and a practicing lawyer of Hartford, Conn. He also fills the lectureship on patent law at the Yale Law School, and is the author of several books on subjects pertaining to patent law. He was a member of the LIst Congress and had been a member of the Connecticut Legislature for several years. He was elected Speaker of the House in 1885. He is a man of sterling integrity, of judicial mind, abundantly qualified for the Commissionership. The Patent Office under his management will not be likely to move backward. We wish for his administration the utmost success.

It is perhaps fitting that the Patent Commissioner should hail from Connecticut. In area it is a small State, but its people have large heads, if we may judge from the records of the Patent Office. In proportion to population, the sons of Connecticut take twice as many patents as any other State.

THE CALDERA NAVAL FIGHT.

The present war in Chile is being watched and studied with keen interest by our army and navy officers and many others, and, although the reports from that country are now meager and the truth is badly snarled up with rumors, yet when reliable information is received the result will be that many useful lessons will be learned and that many improvements will be suggested in war material and its handling.

The recent action in Caldera Bay is attracting much attention, and, now that we have the report of so reliable an officer as Admiral McCann, we can study the action a little closer. The admiral's report is dated Valparaiso, Chile, April 29, 1891, and according to it the Blanco Encalada, a war ship in the service of the insurgents, was lying at anchor in the harbor of Caldera, when she was attacked about 4 A.M., of April 23, by two torpedo cruisers, the Almirante Lynch and the Almirante Condell, in the service of the Chilean government. The Encalada was sunk by the explosion of one or more torpedoes fired by the torpedo cruisers, and about one hundred and fifty men lost their lives.

The first point that strikes one, in reviewing this affair, is the statement that "the morning of the attack was perfectly clear, the light in the lighthouse burning brightly, and the ship's lights perfectly visible, so that the torpedo boats had no trouble in making the attack." The question arises, Why did not the Encalada sight the Lynch and Condell in time to make preparations to give them a warm reception, and why did she not make such preparations?

"The commanding officer admits that he alone was to blame for the catastrophe." What an admission, and what manner of man this commanding officer must be! We have an old lesson forcibly illustrated right here—that a ship may be well found in every particular, having the most modern appliances and most perfect machinery, and yet, if that very important equipment, the captain, is inefficient or unequal to his trust, the ship is a hopeless failure and her loss is to be expected. As we must have skilled mechanics to run complex machines, so must we have skilled and reliable officers to handle our war ships.

"The usual precautions adopted in time of war were entirely neglected," and it might be added that many of the precautions usually adopted in well regulated ships in time of peace were also neglected. Had a proper lookout been kept, had a signal station been established on the point, there is no doubt but that the Encalada would have known of the approach of her enemies in sufficient time to have cleared ship and gotten ready for action. Had the guns been loaded and had the cable been ready to slip, she might have inflicted such an amount of damage to the Lynch and Condell, and might have so maneuvered, as to render

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the attack less disastrous, or at least punished her assailants more severely.

Another point to be noted is the number of torpedoes fired. One account says three were discharged before an effective hit was made, another says seven. Whichever number is correct, it shows, considering the circumstances, that even the best form of torpedo is an unreliable weapon, but if a hit is made, the effect is appalling.

The Lynch and Condell are recently built torpedo cruisers of the latest design, and the torpedoes used are the most modern development of the Whitehead auto-mobile torpedoes.

The Encalada was an iron armored, twin screw, central battery ship, 219 feet in length, 45 feet and 9 inches in beam, 19 feet and 8 inches in draught, and of 3,500 tons displacement. She carried six 12 ton, muzzle loading Armstrong rifles, four lighter pieces, and seven machine guns. In the SCIENTIFIC AMERICAN of June 6 will be found a full description of the Lynch and the Condell. B.

THE DISPOSITION OF MINING DEBRIS IN CALIFORNIA.

Among the reports submitted to the last Congress was one from the Secretary of War on the treatment of mining debris in California. The report contained the conclusions of the Board of Engineer officers which was prepared in compliance with an act of Congress, approved October 1st, 1888, which directed that three officers from the Engineer Corps of the United States army be constituted a commission for the purpose of making a thorough examination of the mining debris question in California, and determining whether some plan cannot be devised whereby the present conflict between the mining and farming sections may be adjusted, and the mining industry rehabilitated.

For several years past hydraulic mining has been suppressed in California. In the early stages of placer mining the possible effect upon river channels and adjacent lands of dumping debris in the cañons does not seem to have received any attention. No great flood was recorded until 1861-62, when very serious damage was done by the overflow of certain rivers, notably the Yuba, and other floods occurred in 1875. After a number of decisions by the lower courts the United States Circuit Court rendered a decision which puts a stop to hydraulic mining in the State.

It was estimated that $100,000,000 was invested in this branch of mining previous to the restriction, the effect of which has been that many costly works connected with this industry have been allowed to go to decay, mining camps have been deserted and large districts depopulated, while the yield of gold in the State has been considerably reduced, as shown by the following table.

Product of gold in California from January 1, 1880, to December 31, 1890.:

1880	$17,745,745
1881	17,166,676
1882	15,520,325
1883	13,841,297
1884	12,896,594
1885	12,338,014
1886	13,208,034
1887	11,836,957
1888	10,076,091
1889	10,329,044
1890	9,986,851

In the prosecution of hydraulic mining all the material in the bank is moved, whereas in drift mining only the gravel and sand adjacent to the bed rock is taken out. It follows as a consequence of hydraulic mining that some depository for the debris must be found, and until the decision of the United States Circuit Court was rendered, this debris was dumped into the gulches and beds of streams adjacent to the mines, to be removed further down with the winter freshets.

The effect of filling up the river beds in this way was very disastrous to farmers and other persons owning land which was overflowed, and resulted in the formation of the Anti Debris Association, which organization has conducted the litigation resulting in the inhibition upon hydraulic mining. In one of the cases in this extended litigation the following facts among others were brought out. The plaintiff was the owner of a lot in the city of Marysville covered by a brick building and of two farms on the borders of the Feather River. Portions of these two farms were covered by debris brought down by the floods of 1862 to a depth that made them valueless as agricultural land. The winter floods of succeeding years added to the depth of the deposits and the lands are now grown up to willow and cottonwood thickets. The beds of the Yuba and Feather Rivers gradually rose from successive deposits of debris, until in 1868 the people of Marysville found it necessary to build levees to protect the city from overflow. The city is situated upon a high bank of the Yuba River and about one mile from its junction with the Feather.

Up to 1862 the Yuba was navigable all the year for ships and boats drawing from 9 to 10 feet of water, and during the winter season deep water ships from around Cape Horn navigated it to the foot of E Street. The site of the city was above extreme high water, and it was never overflowed until after the commencement of modern hydraulic mining. The river beds continued to rise after the building of the levees, and during the flood of 1875, which was much less in volume than in 1862, the levees broke, and for the first time in its history Marysville was inundated. A report to the legislature during the session of 1880 states that during the year 1879, 40,564,000 cubic yards of material were put into the Feather River by the hydraulic mining process and 9,700,000 cubic yards of this debris, about 24 per cent, passed out in suspension. Most of the material so carried in suspension was deposited in the lower Sacramento and in the bays in which the Sacramento discharges.

The above statements clearly indicate the nature of the damage done to streams by dumping mining debris where it will be washed into them, and the consequent injury to property by the overflowing of streams in which large quantities of mining debris have been deposited. The labors of the commission of United States engineers, were directed to ascertaining the amount of damage which had been done to various streams by dumping mining debris into them, and the formulation of a plan by which the injurious effects of this course might be obviated, and hydraulic mining resumed without injury to any other interest.

There are large bodies of workable gravel yet remaining, that could be worked at a fair profit, and, in the opinion of many persons who have given thought to the subject, dams could be erected for the impounding of the mining debris, and thus prevent the filling up of the stream.

The conclusions of the engineers on this method of remedying the evil are given at length. They say: "The board is of the opinion that some partial protection could be afforded the rivers and lands below by restraining a portion of the coarser part of the material mined by structures built in the cañons, ravines, and valleys at points where examinations have indicated the most favorable locations. These works should be permanent stone dams or barriers built across the beds of cañons and carried to such heights as the local conditions may demand. The results obtained by dams now in existence show the feasibility of impounding portions of the coarser material behind properly constructed barriers. As the stability of the dam depends in a great measure upon the apron, the greatest care should be taken in its construction. An economical construction could be obtained by building a low structure first, and raising the succeeding ones upon the impounded material. The faces of these dams would then constitute a series of falls, which would have the effect of breaking the force of the water upon the apron. That considerable coarse material can be stored is shown by the dams already constructed in some of the tributary streams. In Slate Creek material is impounded by two crib dams. The upper one, immediately below the Poverty Hill mine, banks up debris over 27,000 feet on a grade of 50 feet per mile." A number of other cases are cited where mining debris is stored by means of dams.

In concluding their report, the engineers refer to the injuries to the rivers of the Sacramento Valley by the deposition of vast quantities of mining debris in the beds, and reaffirm their faith in the possibility of impounding the debris without injury, and locations are pointed out where this may be done.

The question as to whether the damage from mining debris may be prevented by the erection of dams across streams into which such debris has been washed, was passed upon by the courts in the litigation which resulted in the decision by the United States Circuit Court which renders hydraulic mining in California illegal. In the action brought by the Attorney-General of the State for a perpetual injunction restraining a certain mining company from dumping debris where it would be washed into the river, the lower court granted the injunction prayed for, but affixed a condition in the decree that when efficient means should have been provided to impound the heavier portion of the debris, the defendant should be entitled to have the injunction dissolved. The people appealed from the condition affixed to the injunction, and the Supreme Court affirmed the injunction without any conditions. Judge Sawyer, in that portion of his decision relating to the erection of dams as a remedy for the evils, said: "Whether a dam can be constructed to stand the pressure to which it will necessarily be subject under these circumstances, and whether it will be of any material use in preventing the flow of the debris, and the filling of the river below, are questions upon which I am not fully advised; but from the evidence in the case, and of my observation of the premises, I am strongly impressed with the belief that sufficient of the debris will still pass over the dam in suspension with the water to maintain and even increase the present fill of the river.

"Besides, it is a very serious question in my mind whether any person or community can or ought to be required to submit to the continuous peril of living under or below such a dam as this must necessarily be if it be made high enough to impound the coarser material—and this merely for the convenience of another person in the pursuit of his or their private business. It may be likened at least to living in the direct pathway of an impending avalanche."

The report goes very thoroughly into all details affecting this question, and is signed by Lieut.-Col. W. H. H. Berry and Major W. H. Heuer and Major Thomas H. Handbury, of the Corps of U. S. Engineers.

Opals.

At a recent meeting of the California Academy of Sciences, the following paper was read by Melville Attwood, M.E.:

The precious, or noble, opal is one of the most beautiful gems in nature. When held between the eye and the light, it appears of a pale milky reddish blue, but when seen by reflected light, it displays all the colors of the rainbow.

Opals are always cut *en cabochon*, on both sides, and the true beauties of the gem only display themselves when the stone is moved about, as then a fine opal really appears to have an actual life within itself.

Fine stones of a large size are rarely found. They seldom exceed an inch in diameter. When held in the hand to impart warmth to the gem, it is much more brilliant.

Some varieties of opal (the common) are found with galena and blende in metalliferous veins. They also occupy the interior of fossils in sandstone. Its formation is due to the solubility of amorphous silica in water, especially in hot water, or water containing carbonic acid, the silica being dissolved out by spring waters from decomposed silicates, and deposited under favorable circumstances in a state more or less approaching to purity.

At a former meeting I presented the Academy with opals in the matrix from the State of Washington. Since that I have cut another microscopic section of the Washington rock, which I now donate to the Academy. The section shows the rock to be basalt, consisting of a mixture of fine grains of labrador, feldspar, etc., with a small quantity of magnetic iron.

Through the kindness of Adolph Sutro, Esq., I am now enabled to give the Academy specimens of opals in the matrix from Mexico, Australia, and Hungary.

The inclosing rocks of those from Mexico and Australia are so altered, or decomposed, that I could not cut a satisfactory section from them. They are, however, without doubt, trachytes. The two specimens from Hungary are very interesting, being the same rock, but the one much altered or decomposed and the other fresh or unaltered. From the latter I managed to cut a section sufficiently thin to prove it to be a trachyte, with small crystals of leucite in it.

The result of my examination of the inclosed rocks of the different precious opal deposits, and from all the information I can obtain by papers written on the subject, is that the precious opals occur, or are found, mostly in dikes of intrusive volcanic rocks, and in those parts of the dike near the surface, and where the rocks are greatly altered or decomposed.

Naval Torpedoes.

A permanent board of torpedo experts has been recently established by the Navy Department to take charge of experiments, tests of firing and launching tubes, installation on board, stowage, and torpedo supplies. It consists of Commander G. A. Converse, senior member; Lieut. F. J. Drake, and Lieut. T. C. McLean. The headquarters of the board will be at New York, with experiments conducted also at Providence and Newport, and practical steps have been taken to obtain a supply of torpedoes for our war vessels at an early day. Messrs. E. W. Bliss & Co., of Brooklyn, N. Y., having arranged with the proprietors of the Whitehead torpedo for its manufacture in this country, the Navy Department has contracted with that firm to make one hundred of these torpedoes at $2,000 each, and parts to be added by the Carpenter Steel Company will considerably increase the cost. Thirty torpedoes of the type invented by Capt. J. A. Howell, of our navy, have also been ordered, at a cost of $2,200 each, and it is expected that the first of these will be ready for trial in August.

The competitive tests of these two torpedoes will be looked for with much interest, particularly as public attention has been so strongly directed to the performance of the Whitehead torpedo by its work in the recent sinking of the Chilean warship the Blanco Encalada, as described in the SCIENTIFIC AMERICAN of June 6. In the Howell torpedo there are four sections. The first contains the firing pin and its mechanisms; the second, just behind it, the explosive charge and detonator; then comes the third, containing the flywheel and screw gears; finally, the stern, which holds the driving mechanism. The characteristic feature of this torpedo is the heavy flywheel which propels it, and which is spun up by a steam turbine motor, which forms a permanent attachment of the launching tube. The torpedo having once been placed in the tube, the steam motor clutches the flywheel, and when steam is applied it spins up the latter, and all the succeeding movements until the torpedo reaches its target and is exploded are performed automatically.

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Brick Making, from a Trade to an Art.

The great size and height of modern buildings in our large cities has compelled more attention than ever to fire-proof construction. Twenty years ago, iron was the preferred material, taken presumably for its fire-resisting quality. But conflagrations like those of Chicago and Boston demonstrated that iron was the worst possible material. Then followed a general use of stone. Brick was not preferred from its then lack of artistic appearance and want of capacity for effect and expression. Stone, however, proved unreliable as a fire-resisting material, and some of them, in fact all except the sandstones, were found to easily disintegrate with the heat of a common, not to say a great, conflagration.

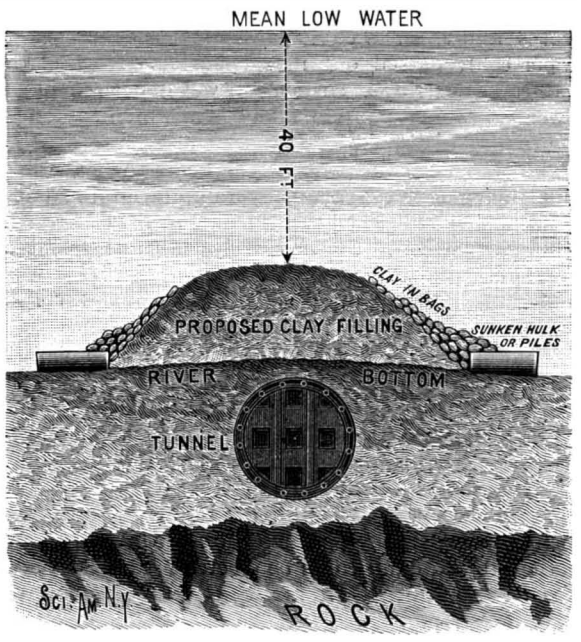
But brick making has developed from a common mechanical occupation into an art. Forms have altered from the stiff 4x8 formula, to suit artistic situations in fronts, pilasters and cornices, and finally the crowning development is reached in the rapid and cheap production of the most elegant art forms and expressions in terra cotta, until now clay workers produce the best material for the most pretentious or elaborate structures, while retaining and in fact increasing the well known fire-resisting qualities.

Only one thing is yet desired in order to render fire-proof conditions absolute, and that is a fire-proof mortar. The brick itself is practically indestructible by any heat in a conflagration. The mortar will crumble, with its lime base, and weaken the wall. A mortar has recently been invented by a German chemist that answers perfectly, it is said, but its great cost precludes its use, except, perhaps, for some particular purpose, as fire-proof vault construction, where expense is no object. There is not a single field for invention that would reward the one better who can discover a mortar that would be both fire-proof and sufficiently cheap to be available.

But, however, brick and terra cotta are being generally preferred, and never has there been such general preference shown for these materials as is foreshadowed for the coming season. Safety and durability are beginning to usurp all other conditions in the erection of large buildings—a usurpation that has been rendered permanent to brick and terra cotta by their becoming thoroughly artistic.—*The Clay Worker.*

PROGRESS OF THE NORTH RIVER TUNNEL.

The progress of work upon the North River tunnel has brought the main heading to a critical point. The rock upon the New York shore has been almost reached and the problem of getting over or through it



SECTION OF RE-ENFORCING FILLING OVER THE TOP OF THE TUNNEL.

now presents itself. The original plan would have carried the tunnel right through the crown of the rock, necessitating blasting, with its attendant dangers and risk. The present contractors propose to attack the matter differently. Starting well back from the shore, at about the 3,800 foot mark, measuring from the west or New Jersey end of the tunnel, they propose to increase the up grade to two per cent and to approach the eastern terminus on an even slope. This will carry the line over the summit of the rock, as shown in the upper cut.

In doing this the bottom of the river is nearly reached, but five feet of silt and clay lying above the arch or top of the tunnel at one place. This introduces an element of danger. The air pressure system as applied to sustaining a vertical heading introduces an element of unstable equilibrium that can only be counteracted by a large overlying depth of solid material. If the tunnel had but five feet of wet silt or sand over it, there would be great danger of a disastrous and perhaps fatal collapse. Just above the tunnel there is a deep channel, giving a very characteristic section to the river at this point. The sudden deepening is the cause of the trouble. The method of dealing with the problem that is proposed is the following.

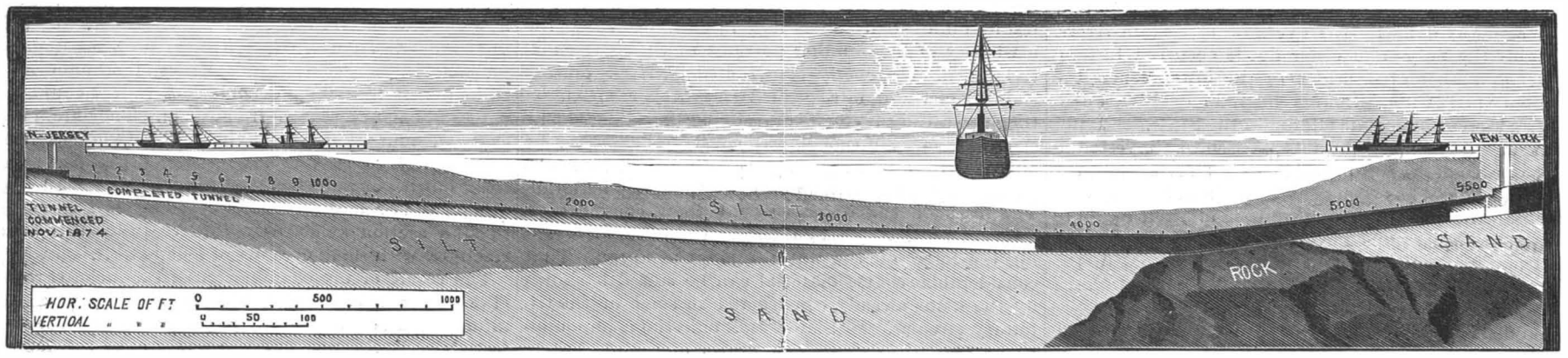
Good clay properly prepared is to be dumped into the channel at slack water, immediately above the line of tunnel. This will be continued until the depth of earth over the line of the top of the tunnel is increased to at least twenty feet. The depth of water at the critical places is from sixty to sixty-four feet. The filling to be introduced in no case is to reduce this depth to less than thirty-one feet six inches at low tide: 15,000 to 20,000 cubic yards it is thought will suffice.

To secure the mass from washing away, it may be put in bags wholly or in part and riprap and even piling, if necessary, may be used at the sides. The general section of the re-enforcing mass is shown in one of the cuts.

Upon completion of the work the filling will be useless and the clay is to be dredged out and the river bed left in its original condition. Any injury done to neighboring piers from scouring is to be paid for by the tunnel company.

The approval of the acting Secretary of War has been received, based upon the recommendation of a board of engineers consisting of Cols. Henry L. Abbott, C. B. Comstock, and G. L. Gillespie. Adequate safeguards in the way of supervision by the war department, and consent of the supervisor of the harbor of New York, with a bond of $200,000, have been arranged for in the permit.

From an engineering standpoint the proposed operation is of considerable interest. The weak point in the compressed air system of tunneling, which has been the sustaining a vertical heading, has been met, to a great extent, by the shield. This, by subdividing and protecting the exposed vertical area, has made the work safer. The adding to the overlying layer of earth operates in the same direction and appears quite adequate to overcome the weakness of the bottom. The sectional view of the river and tunnel is also of interest, as showing how far the work has progressed. It will be seen that but little remains to be done to complete the connecting link between the New York and New Jersey shores.

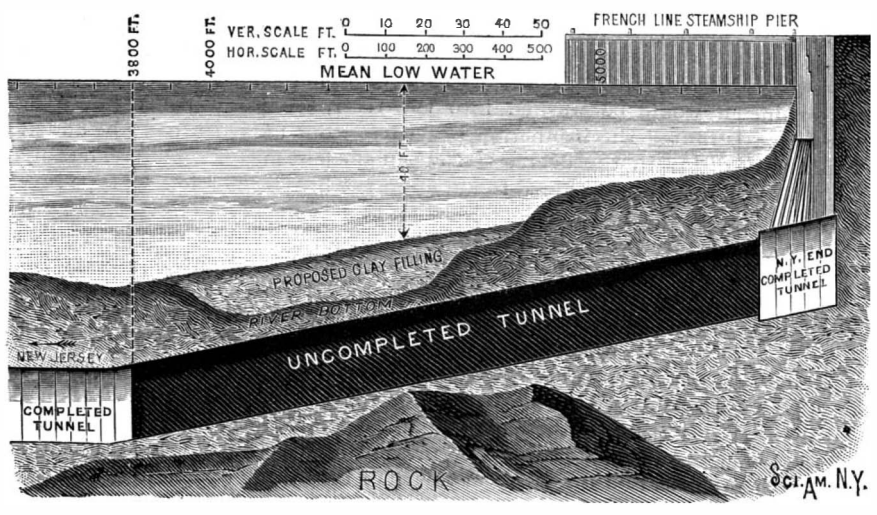


THE NORTH RIVER TUNNEL—SECTION SHOWING THE PROGRESS OF WORK.

Government Note Paper.

Anybody who wishes can go into the big Crane & Co.'s factory at Dalton, Mass., and see the workmen place the blue silk on the machine that makes the paper for all the United States notes. The silk comes in spools, and is made by Belding, of Northampton. It is sold here in Bangor. There is no more secret about it than there is about the water flowing over the dam above the toll bridge. The real secret is in the composition of the paper. The silk thread idea is secured by patent, to be sure, but the making of the paper, the compound of the ingredients, is safe in the head of J. Murray Crane, who received the art from his father, who made bonds for Salmon P. Chase, Lincoln's Secretary of the Treasury, away back in war times. The pure linen pulp is in a big room, looking for all the world like any linen pulp. Then comes J. Murray Crane with a gripsack. He and the "grip" enter the room together, and it is presumed that he locks the door, for the door is locked on the inside, and the "grip" does not look able to do it. They are closeted a half an hour. When they come out the pulp goes to the paper machine, and Mr. Crane and the grip go home. But the pulp is changed by that visit, and nobody has been able to penetrate the Crane secret. The company gets about fifty times as much for that paper as for other linen paper made in the same mill.—*Bangor News.*

A STICK of California redwood is being prepared in Detroit for the World's Fair. Its dimensions are given as 16 feet wide, 13 feet long and 5 inches thick.



THE EASTERN GRADE—SURMOUNTING THE ROCK.

A Volatile Compound of Iron.

On this subject a paper was lately read before the Chemical Society, London, by Mond, Langer, and Quincke.

Pursuing the researches which led some little time ago to the startling discovery that nickel formed with carbon monoxide the volatile compound $N(CO)_4$, these investigators have obtained a similar body containing iron. Its preparation is difficult, and the yield scanty. The method adopted consisted in reducing ferrous oxalate in a stream of hydrogen at a temperature of 400° C., and passing carbon monoxide over the product heated to about 80° C. Like the nickel compound, the new body is volatile, and is decomposed on heating, depositing a mirror of metallic iron. The supposition that (as but little of the substance can be obtained even from large quantities of iron) the formation of the mirror may be due to the presence of a trace of nickel in the original iron salt is negatived by the fact of the deposited metal giving the reactions of iron, and thereby allowing its identity to be definitely established.

It can be readily understood that as only extremely small quantities of the new substance could be obtained, its satisfactory analysis was difficult; but the authors' numbers point to its being of composition similar to that of the nickel compound and consider it to be represented by the formula $Fe(CO)_4$.

The bearing of the existence and properties of the new substance upon the cementation process for converting iron into steel was discussed.

It appears unlikely that the substance $Fe(CO)_4$ is an agent in this conversion, inasmuch as it is decomposed at 150° C., but it may well be that the transference of carbon, that undoubtedly takes place, is due to the activity of some similar body.

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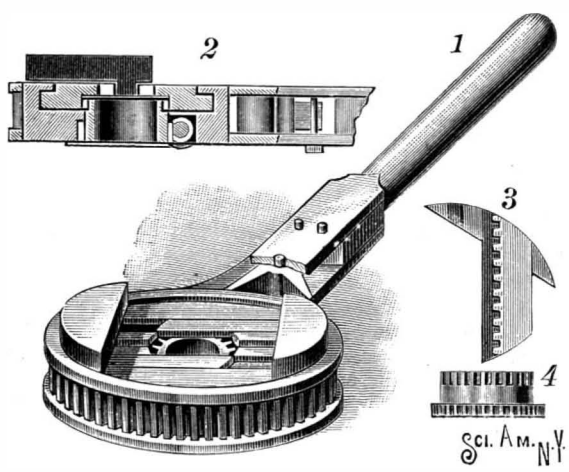
AN IMPROVED WRENCH.

The tool shown in the illustration has a wide range, for adjustment to various sizes of nuts, and is of such form that it may be conveniently used in places where it would be impossible to employ the common forms of wrenches. Fig. 1 is a view in perspective, partly broken away, Fig. 2 being a longitudinal section, while Fig. 3 shows one of the jaws and the sliding block to which it is fixed, and Fig. 4 represents the central gear for operating the parts. Two circular bands, with shanks attached to the handle, inclose the circular body of the wrench mounted in the head, and extending across the face of the body are undercut parallel recesses to receive the sliding blocks of the jaws, there being on the opposite face of the body a circular recess to receive the center gear, and a side recess in which the worm for



McINTOSH'S WRENCH.

operating the gear is mounted. The jaws protrude from one face of the wrench, and are made integral with the sliding blocks, the jaws also having depending tongues moving between parallel bars of the wrench body, which guide and strengthen the jaws, the bars being cut away in the center to permit the passage of a bolt through the wrench. The central gear has teeth on its inner end engaging with the teeth on the jaw blocks; and on its larger end are teeth engaging a worm, mounted in a recess at right angles to the gear, the worm having at its outer end a milled thumb-wheel, by turning which the gear will be actuated to force the jaws together or apart. Pivoted in the shank portion of the wrench is a two-armed pawl, either arm of the pawl being adapted to engage the teeth on the circumference of the body portion of the wrench mounted in the head, according to the way the wrench is to be turned. The desired adjustment of the pawl is effected by means of a spring plate, which projects from the rear portion of the body, in position to engage one of two pins in the rear portion of the wrench shank, by means of which the pawl may be held with either arm in engagement with the wrench body.

This improvement has been patented by Mr. C. A. McIntosh, of No. 709 Sixth Avenue, Vancouver, British Columbia, Canada.

THE HORTICULTURAL BUILDING.

The illustration given representing Horticultural Hall, of the World's Columbian Exposition, is from the approved designs, and will be of great interest. The building is situated immediately south of the entrance to Jackson Park from the Midway Plaisance, and faces the lagoon. In front is a flower terrace for outside exhibits, including tanks for nymphæas and the Victoria regia. The front of the terrace, with its low parapet between large vases, borders the water, and its center forms a boat landing.

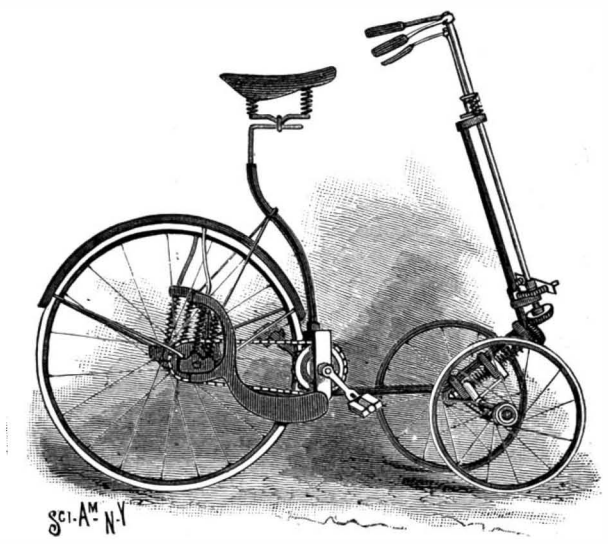
The building is 1,000 feet long, with an extreme width of 286 feet. The plan is a central pavilion, with two end pavilions each connected to the center pavilion by front and rear curtains, forming two interior courts, each 88 by 270 feet. These courts are beautifully decorated in color and planted with ornamental shrubs and flowers. The center pavilion is roofed by a crystal dome 187 feet in diameter and 113 feet high, under which will be exhibited the tallest palms, bamboos, and tree ferns that can be procured. There is a gallery in each of the pavilions. The galleries of the end pavilions are designed for cafes, the situation and the surroundings being particularly well adapted to recreation and refreshment. These cafes are surrounded by an arcade on three sides, from which charming views of the ground can be obtained.

In this building will be exhibited all the varieties of flowers, plants, vines, seeds, horticultural implements, etc. Those exhibits requiring sunshine and light will be shown within the rear curtains, where the roof is entirely of glass and not too far removed from the plants. The front curtains and under the galleries are designed for exhibits that require only the ordinary amount of light. Provision is made to heat such parts as require it.

The exterior of the building is a staff or stucco, tinted a soft, warm buff, color being reserved for the interior and the courts. The appropriation for this building is $400,000. It will probably be built for something less than this sum. The architect is Mr. C. O. Jones.

AN IMPROVED VELOCIPEDE.

The illustration represents a simple and effective mechanism for steering or guiding a velocipede, the construction being such that when two small forward wheels are employed both of them may be made to act as steering wheels. The guard for the rear drive wheel is also maintained at the same distance from the periphery of the wheel, whether the latter be raised by obstructions or travels upon smooth ground. The backbone of the machine is preferably tubular, and each member of the fork at its rear extremity is formed with two spaced horns, somewhat of the shape of the letter C, the rear or drive wheel being mounted on an axle turning in bearing blocks supported on the lower horns. Attached to the axle is a sprocket wheel, connected by belt in the usual way with a sprocket wheel on the pedal shaft, and the guard over the drive wheel is directly connected with the bearing blocks by means of central and side arms, the central arms being carried downward through apertures in the upper horns of the fork. The central arms are slightly curved between the upper arms of the fork and the bearing block, and around this portion are coiled springs. Rods or bars also pass downward from the seat-supporting member, and are secured to the upper and lower horns on each side, these rods passing through apertures in the bearing blocks and springs being coiled around them to rest upon the bearing blocks and bear also against the upper horns of the fork. The guard is thus always held at the same distance above the wheel, but the bearing blocks as they rise compress both sets of springs,



LESSELLS' VELOCIPEDE.

which force the blocks downward as soon as the obstruction is passed. At the center of the forward axle is a block having a circular opening through which passes a short shaft, parallel with a forwardly and upwardly extending portion of the backbone, the shaft being held to turn in hangers or brackets from this member. This shaft has a longitudinal groove in which a rib of the block enters, and between the upper and the intermediate hanger is a second block, which may serve as a bearing for the axle should it be desirable to use forward wheels of a larger size. Springs are coiled around the shaft between the blocks and hangers, and at the upper end of the shaft is a bevel gear meshing with a gear on the lower end of the steering shaft. On this shaft is a regulator, consisting of a semicircular rod, fitted over the upper forward member of the backbone, and carrying coiled springs arranged in such a way that the turning of the steering wheels will compress one of the springs, the wheels being returned to straight position by the springs when the steering shaft is released by the rider.

This invention has been patented by Mr. Allan H. Lessells, of No. 18 Balmoral Road, New Brighton, Cheshire, England.

THE WORLD'S COLUMBIAN EXPOSITION—THE HORTICULTURAL BUILDING.

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Notes of the Amazon.

After Para, Santarem is the most important town on the Amazon, and is 200 miles above the former city. Here is an American colony which is fairly prosperous, a New York gentleman of means taking much interest in it. Cocoa and other staples form the commerce of the place, not much being done in rubber. It has about 200 inhabitants and is fairly healthy.

The river is nothing if not broad. If it were not for the island clumps, one could readily get out sight of land. Let one attempt to cross it in a row boat and he would not fail to appreciate the magnitude of this big river.

It is hardly possible for a great populous nation to obtain a habitation on the banks of the Amazon. It is hardly fitted for the production of food and supplies for a large number of people. Take cotton for instance. A very long white staple grows well, but to clear for it is to do away with the seringa tree, and the latter crop is more profitable than any of the products of the temperate climes. Nature does its own planting, hoeing, everything save the gathering, and comes very nearly doing that, as it only needs the stroke of the machete to set the gum trickling.

The crop is a heavy one. Twenty Indians well fed will make 40,000 lb. of rubber in a season. A day's work for an Indian is a path of one or two miles long in the forest. In this path he will probably find 150 suitable trees which one after another he taps, dexterously cutting so as not to penetrate beyond the bark. To go through the bark and not touch the wood gives the best results, and Indian skill is intuitively cultivated to this end. From his early morning task the Indian returns to camp at 9 A. M., and three hours is spent in breakfast and needed rest. At noon he starts out again for the sap, which he can collect in two hours, and then comes the smoking process. The locality is prominent by the peculiar odor of the burning palm nuts. Follow your nose if it is late in the day and you will soon come to an Indian smoking his rubber. After his fire is started he covers it over with an inverted earthen pan 15 inches high and the same in diameter. This forms an arch, with admission for air at the bottom. A hole in the top of the pan, when inverted, is a passage for the smoke. He next brings from his shed a form say twelve inches long and nine broad, diamond in shape and slightly oval on one side. On this oval side he pours a dipperful of milk, and after it has ceased to drip in the pail, he passes it quickly into the smoke. Moving it quickly, he holds it in the smoke for half a minute, and a change has taken place which is wonderful to the reflective mind. The milk has been set, the white sap has become a layer of fine, tough India rubber. In a twinkling he pours over this layer another coat of milk and again the stick goes into the smoke, a process to be repeated thirty or forty times, or until the mass is thick enough to form the biscuit of commerce.

Usually the biscuit remains on the mould or stick twenty-four hours in order to become dry. When first taken off the mould the cakes are of a light gray color, but this changes gradually into the shade to which we are accustomed.

The quality depends upon the care in making and the conditions in gathering. Fine Para should have no lumps in it, or clotted milk, which is likely to occur on wet days, as water is apt to coagulate the milk.

The curing process is invariably carried on at the forest line. Once milk was transported in cans, but this was speedily abandoned, and primitive methods, however they may look to the eye of system and organization, have been found in practice to be the better.

Wealth lies all around you. One burr from the Brazilian nut tree contains two quarts of nuts. A hundred pounds of them in New York are worth $20. Go over to Brooklyn when the Manaos steamer comes in, and see the wealth in nuts and rubber that is dumped on to the wharf. Cases of rubber of a value of $500 and more roll by you from the top of a cargo whose foundation is nuts.

In the rubber districts, farina is cultivated. This is the only flour that the Indian will eat, and the Brazilian uses it largely. It makes good bread.

Passing from the Amazon into the Madeira, we find the rubber trees more abundant, in fact, it is the great rubber district. It is 2,200 miles long. The change in passing from the Amazon to the Madeira is very perceptible. Now the banks are higher, the country is comparatively dry; and vines and plants are not so marked. Great as the Madeira is, and it is three miles wide at its mouth, it is a child to the mighty Amazon. Fifteen fathoms of water are found in the Amazon 1,000 miles from its mouth, and steamers, war vessels and all sorts of craft pass this point as if it were a mighty ocean. Reflect a moment, how many rivers in America would allow this. The puffing flat bottom steamer is the only vessel on the Mississippi above New Orleans, and all rivers choke off free transportation a few miles from their mouths.

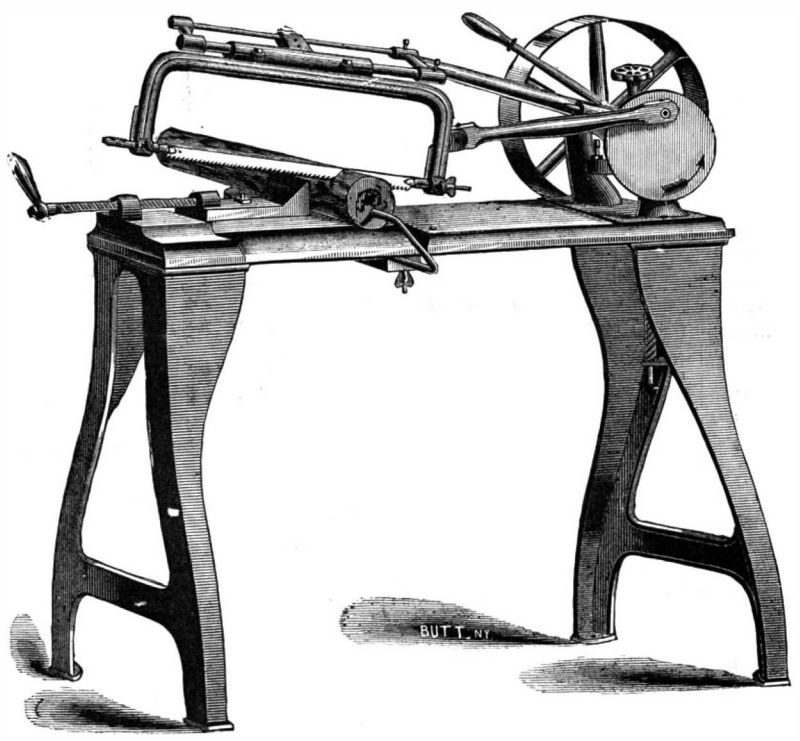
All transportation up the Madeira starts from Manaos, the ideal city of the simple Amazonese. Here the people call the Amazon the Solimoens, and farther up another change is made, and it is named Maranon. Manaos is really on the Rio Negros, but it is near a fork of the two rivers, which junction is one of the sights of the Amazon. The Negros, as its name indicates, is a black stream, not very rapid at this place, but twice as wide as the Solimoens. The two rivers meet at nearly right angles, the blue black of the broad river pressing slowly out the torrent, yellow in color, of the Amazon. The latter, vigorous in motion, dashes fiercely at it, at times holding it back, but as it is colder than the other, it in the end sinks out of sight, passing underneath for miles, when its yellow current emerges in eddies at the surface. The Indians apply realistic names to these two rivers in view of their peculiarities; one they call the "Living River," the other the "Dead."

The impression that the banks of the rivers are full of game and animals is far from correct. One sees very few of the larger animals, even in an extended trip.

The country of course is in the hands of the natives, and will never emerge from its present methods and modes until other nations emigrate to it. If it could be found practicable to introduce systematic labor in the forests, great wealth could be obtained, but the present outlook is not favorable for any such change. —*India Rubber World.*

A POWER HACK SAW.

A powerful little machine for sawing steel and other metal bars is shown in the accompanying engraving. It is manufactured by the Millers Falls Company, of New York City, and is adapted to be run by a belt. One saw blade used in this machine will do much more work than one used by hand, as the speed and pressure are regulated and uniform. We have seen a steel bar 5 inches in diameter that was cut quite clean by this machine. It may be used for cutting railroad rails. The machine runs at the rate of forty strokes a minute, and does its work without attention.



A POWER HACK SAW.

The Public Forests.

We have more than once alluded to a section in the act repealing the timber culture laws, which was approved on the last day of the last session of Congress, and which authorizes the President of the United States, from time to time, to set apart public lands bearing forests or in part covered with timber or undergrowth as public reservations. The final clause of the section reads as follows: "And the President shall by public proclamation declare the establishment of such reservations and the limits thereof." This section has been interpreted as having a more than permissive force. Commissioner Carter, of the General Land Office, has issued a circular to special agents, in which it is held that, for the purpose of carrying into effect the provisions of the act, it is important to reserve all public lands which bear forests or which are covered with timber or undergrowth on which the timber is not absolutely required for the legitimate use and necessities of the residents of the Territory or State in which these lands are situated, or for the promotion of settlement or for the development of the natural resources of the region in the immediate vicinity of the forest lands in question.

The circular goes on to instruct the agents that it is of the first importance to reserve all public lands in mountainous and other regions which are covered with timber or undergrowth, at the headwaters of rivers and along the banks of streams, where such forests are the natural agents for absorbing moisture, checking mountain torrents and preventing the sudden melting of the snow and the floods which follow. Special agents are directed to make a personal examination of such forest lands, and to acquaint themselves in every possible way with the facts as to the value of these lands for all purposes, and such investigations are to be reported to the Land Office. Furthermore, they are to submit a report, with a recommendation in each case, as to whether the lands examined should be set apart as a reservation, together with the reasons for this recommendation. This recommendation and the reasons therefore, with the full description of the lands under investigation, are to be published in the land offices and in the newspapers of the vicinity, and it must be stated that the object of such publication is to give timely notice of the proposed reservation, so that all persons who have any interest, either in favor of or in opposition to its establishment, may have an opportunity to petition or remonstrate. This must be done in time to have these views considered before final action is taken in regard to the establishment of a reservation. Wherever there seems to be any imminent danger to the timber of any particular tract which has been considered as a proper one for reservation, the agent is to report this danger at once and state his reasons for believing that there is necessity for immediate action.

All this is done in order to lay before the President such information as will enable him to take intelligent action thereon. Of course, there are other means of acquiring information which the President can make use of, and it is altogether proper that any one who has any special knowledge in this direction shall place it at his service. The American Forestry Association, we are glad to see, is taking steps to examine certain forest areas in order to ascertain whether they should be reserved from settlement. There is very little danger that the Chief Executive of the nation will include too large a fraction of the public domain in these reservations; and even if lands which are more valuable for agriculture than for their forests should be included, it would be very easy afterward to turn them over to settlers. Indeed, we have urged that all forest lands should be withheld from entry until the data which special agents of the Land Office are now instructed to collect could be ascertained by a commission of scientific men. The present action, however, is much better than no action at all; but what protection is there thrown around these reservations even after the President has made his proclamation to set them apart? So far as we are aware, no legal provision is made for guarding them against depredation or protecting them from fire. It has been our opinion that the United States army was the proper force to use in guarding the forests on the national domain, and we have urged that these forest lands withdrawn from entry should be placed under the charge of the army. This has been done to some extent in the case of the Yellowstone reservation and the great Sequoia reservations of California. If it is practicable to place such reservations as are declared by the President under this same guardianship, we shall feel that something has been done for our forests which promises to have practical value, and the brief section which was attached to an act relating to quite another matter may prove an important piece of legislation in the history of the forests of the nation.—*Garden and Forest.*

A Railway Sprinkler.

The opening of the new Inter-Urban line, between St. Paul and Minneapolis, has discovered the fact that outside the cities and while traversing some six miles or more of the distance which is beyond the pale of the water mains, on certain favorable days the dust is found to be a no small and decidedly unpleasant feature of an otherwise delightful ride. To remedy this evil there is almost finished at the shops of the Minneapolis City Railway a giant tank, made of one-eighth inch boiler iron, and mounted on a flat car carried on four 36 inch wheels. A piece of four inch steam pipe capped at each end, and suitably perforated with small drill holes, rests across the rear platform. The connecting pipes, of the same diameter as the cross pipe, connect it with the tank and insure a bountiful supply of water. It is intended to draw the tank car behind a motor car, and by making a trip every two hours, the entire length of the line will be sprinkled in a round trip of eighty minutes.

THE distance of the horizon is governed by the height of the eye above the earth or sea. On the sea, with the eye at a height of five feet, the distance would be three miles; at sixty feet in height, ten miles.

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Correspondence.

To the Editor of the Scientific American:

In your issue of July 4, in the article on "Florida Phosphate Deposits," Prof. Wyatt speaks in a very discouraging manner regarding transportation facilities in the phosphate district.

Knowing that you do not wish to convey an erroneous impression, I would call your attention to the fact that our company was incorporated by special act of the Florida Legislature on May 13, 1891; we have three surveying parties already at work, and it is intended to have our railroad in operation in one year. It will be the only standard gauge steel railway in South Florida traversing the phosphate districts and enabling the various phosphate companies to deliver directly from the cars to sea-going vessels at deep water. This will not only make traveling a comfort, but correct the present evils spoken of.

Prof. Wyatt, undoubtedly, was not cognizant of our enterprise at the time of writing his article.

As the Arcadia, Gulf Coast and Lakeland Railroad will do so much to overcome these impediments and difficulties Prof. Wyatt mentions, I trust that you will, in the interest of further enlightenment to your readers, give publicity to the facts here stated.

ANTHONY PETERS, *Pres.*

Boston, Mass., July 8, 1891.

Edison's Cosmical Telephone.

To the Editor of the Scientific American:

Your correspondent of last week, in his criticism of Mr. Edison's cosmical telephone, displays either a lamentable ignorance of the principles of physics or a total misconception of Mr. Edison's plans. His chief objection was that there was no interplanetary medium capable of transmitting sound waves. Now from the very construction of Mr. Edison's apparatus it is evident that the waves that he operates with are not *sound* waves, but *electro-magnetic* waves.

The solar tempests give rise to these electric waves, which cross space with the velocity of light, and cause magnetic disturbances on the earth. The object of the cosmial telephone is to change these electric waves into sound waves and render them audible.

Regarding the supposition that the sounds heard by Mr. Edison in the experiment with the long distance telephone were of seismic origin, I should say that Mr. Whitmore had confounded the *electric* with the *acoustic* telephone. No earthquake jars acting on a telephone line would be audible in the receiver unless they were accompanied with some magnetic disturbance.

It is hardly reasonable to suppose that Mr. Edison is ignorant of the elementary laws of physics, especially in the branches of acoustics and electricity. Whether or not his experiment is successful, his theory is perfectly sound.

R. W. WOOD, JR.

Jamaica Plain, July 3, 1891.

The Cosmical Telephone.

To the Editor of the Scientific American:

Referring to the communication of Mr. E. B. Whitmore, in your issue of July 4, on Edison's cosmical telephone, it would seem that the writer has misconstrued the meaning of the article to which reference is made.

Is it to be supposed that Mr. Edison expects anything like the direct transmission of sound waves from the sun by any material medium such as air? It is pretty thoroughly determined that there is a relation of some sort between the disturbances on the sun's surface and the electric and magnetic terrestrial disturbances. It has been shown that the existence of such disturbances, as evidenced by sun spots, is practically coincident with the electrical storms on the earth. It being assumed that the velocity of light and electricity are practically the same, there would seem to be no reason why Mr. Edison should not hear, in the cosmical telephone, sounds caused by electric and magnetic induction due to the activity of the sun. If a person should speak in a telephone in Chicago, he would not expect to wait hours for the sound to reach New York through the medium of the air when it could be transmitted by the inductive action of the telephone in a period almost infinitely short.

New York, July 4, 1891. GEO. M. HOPKINS.

Edison's Cosmical Telephone.

To the Editor of the Scientific American:

In your issue of July 4 a correspondent comments upon Edison's "Cosmical Telephone," and, judging from his remarks, is evidently misinformed as to the theory upon which the experiments are based.

He supposes that Mr. Edison proposes to deal with sounds transmitted directly from the sun, which, as he correctly reasons, would indeed be impossible.

What the great inventor does take advantage of in his attempt to reproduce the supposed noises at the sun is the fact that that heavenly body produces, or is supposed to produce, magnetic disturbances in the iron mountain which he has surrounded by a number of turns of wire. The action then is the same in principle as the ordinary Bell telephone.

These magnetic variations and disturbances set up a varying electric current in the wire surrounding the iron mountain, and passing through the helix of a telephone receiver, cause its diaphragm to vibrate corresponding to the undulations of the current, thus producing sound.

Thus it will be seen that the sounds heard at the cosmical telephone receiver are purely local, depending for their existence on the magnetic disturbance of the iron mountain, and are totally independent of any material medium existing between the sun and earth. It may be that the magnetic effects produced by the sun on the iron mountain are unaccompanied by sounds at the sun itself; nevertheless any magnetic disturbance at the mountain, no matter what its origin, will create sounds in the telephone receiver.

In conclusion, then, we may reason that the sounds heard at the cosmical receiver in no way depend upon material medium existing between sun and earth, or that the existence of sounds heard at the cosmical receiver need necessarily imply that corresponding sounds, or even any sound at all, exists or is created at or by the sun during its influence on the iron mountain.

FRANK MCMILLAN.

191 S. Desplaines, Chicago.

PHOTOGRAPHIC NOTES.

Photographs on Silk.—Those chemists who are practical photographers can well utilize silk for presenting their customers with souvenirs—sachets, almanacs, etc.—at Christmas time. Sensitized silk can now be obtained commercially, but there is not much difficulty in preparing it. China silk we have found to be the best, and there is a great variety of ground tints to choose from. The silk must be well washed to free it from dressing, and then immersed in the following solution:

Common salt	4 grammes.
Arrowroot	4 "
Acetic acid	15 cc.
Distilled water	100 cc.

The arrowroot is dissolved in the water by the aid of a gentle heat, and then the other ingredients added, and finally—

Tannin	4 grammes,

dissolved in—

Distilled water	100 cc.

are also added, and the mixture filtered. The silk is allowed to lie in this salting bath for three minutes, hung up to dry, and afterward sensitized on a silver bath as follows:

Nitrate of silver	3 grammes.
Distilled water	25 cc.
Nitric acid	½ drop.

The silk is floated on this for one minute, then hung up till surface dry, and finally pinned out on a board till thoroughly dry. It is printed in the usual way, and washed and toned as usual, though we have found the mixed acetate and sulphocyanide bath give the best tones.

A New Silvering Bath.—M. Dagreve, in *Les Annales Photographiques*, suggests the following method of silvering old plated or copper articles, which may be useful to any chemist who has some old fixing baths and some worn electroplate: The articles to be plated are well washed with soap and water and then immersed in an old fixing bath which has been used for fixing plates. In a very short time a deposit of silver forms, and then the article should be taken out, rinsed, polished with a soft leather, and again immersed till the deposited silver is thick enough. When an extra thick coating is desired, a piece of wire is affixed to the object, and at the other end of the wire a sheet of zinc, allowing 1 square centimeter of zinc to every square decimeter of the article to be plated. It is not advisable to use old print fixing baths for this purpose, as the silver has a peculiar yellow tinge; but chloride of silver which has not been exposed to light may be used.

Iodides in the Developer.—Herr Lainer, of the Vienna Institute of Photography, has been examining the action of iodine and iodides in hydroquinone, eikonogen, and pyro developers, and has found that their action is precisely the opposite to that of bromides; the latter, as is well known, tending to the increase of contrast, whereas iodine and iodides tend to produce reduction of contrast, and, if used in excess, to very flat negatives. A 1 per cent solution of iodine in equal parts of alcohol and water is recommended, and the addition of 2 or 3 drops of such tincture to every ounce of developer has a striking effect.

Borax in Developing Solutions.—The addition of borax to developing solutions has often been noticed to retard development, yet borax is distinctly alkaline. The apparent anomaly has been explained by M. Aug. Lambert, who calls attention to the well known fact that borax reacts with the polyhydric alcohols, liberating boric acid. The same thing takes place with pyrogallol and hydroquinone. Thus, borax added in small quantities to pyrogallol converts it into a true acid which reddens litmus. It is the same with tannin and pyrocatechin, so that with these substances the addition of an alkaline borate is equivalent to the addition of an acid, the salt in this case causing retardation. But this reaction is not produced with the isomers of pyrocatechin, *i. e.*, hydroquinone and resorcin. Neither is it produced with the ether-developing agents now in use. Here borax does not give rise to any acid, and acts merely by its alkalinity.

A New Platinum and Gold Toning Bath.—A well known amateur, the Rev. H. B. Hare, has suggested the use of the ordinary gold and borax toning bath and then a platinum bath for ordinary albumen prints. The prints are just wetted, then immersed in the ordinary borax bath A:

(A)

Chloride of gold	2 grains.
Borax	90 "
Water	12 ounces.

The prints are allowed to remain in this till they assume a warm brown color, are then removed and placed for a minute in clean water, and then placed in the platinum bath B:

(B)

Chloroplatinite of potassium	24 grains.
Citric acid	60 "
Salt	96 "
Water	12 ounces.

When they quickly assume a fine purple black.

Reducing Over-dense Negatives.—Belizki recommends the following formula. It must be mixed in the order given:

Water	200 parts.
Potassium ferric oxalate	10 "
Sodium sulphite (neutral)	8 "
Oxalic acid	3 "
Sodium hyposulphite	50 "

It will retain its working strength if kept in the dark, and may be used over and over, so long as it has a green color.

Photographic Perspective.—Very few photographs of landscapes are correct in perspective. Mr. A. Mallock has been disscussing in *Nature* the optical factors which determine this, and in the course of his article he says that any photograph taken with a lens of less than about a foot focal length must exaggerate all the distances or make objects in the picture look smaller than they should. The only remedy for this, in his opinion, is to enlarge the picture until the right distance to view it from becomes also the convenient distance. Even if this be done, however, there is still a tendency to view the picture too far off; for few lenses, except those for portraits, embrace an angle so small as to be taken in at a single glance, and people are naturally inclined to stand far enough from a picture to see the whole of it at once. Still, a proper amount of enlargement offers the best means of making a photograph give a true idea of the scene which it represents; and this is especially true of the small pictures taken by so-called "detective" cameras, having lenses varying from four to six inches in focal length; and it is for this end, and not, in general, to enable more detail to be seen, that the enlarging process is most useful.—*Chemist and Druggist.*

Direct Positives.—At the Royal Society's soiree recently, Professor Emerson Reynolds exhibited a series of new derivatives and had a paper on the subject at the Chemical Society, on May 7, where the photographs were also exhibited. It is tetrathiocarbamidammonium bromide $(H_4N_2CS)_4H_4NBr$, which is the most effective agent, the presence of only one-hundredth of a grain per ounce of "eikonogen" developer causing the negative image that first appears to change into a rich colored positive. The series of six small photographs show the process of reversal interrupted at different stages, so that the transition from a negative to a positive can be traced. At the Chemical Society, Mr. Groves drew attention to the curious fact that the silver deposit, which, in the early stage of development, apparently behaves like that forming an ordinary negative image, in the later stage becomes soluble. It will be a splendid thing, says the *Chemist and Druggist*, for lantern photography if this process is perfected; but as yet it can only be considered to be in the experimental stage.

Design for a Very Fast Steamer.

Messrs. James and George Thomson, Glasgow, have modeled a new steamer guaranteed to steam at the rate of 23½ knots an hour, which will enable the vessel to cross the Atlantic within five days. The vessel is to be about 630 ft. long by 70 ft. beam. The lines are very fine. The new vessel will have twin screws 22 ft. or 23 ft. in diameter, well supported. There are four funnels, and about 200 ft. of the length of the ship is left for the boilers and bunkers. The engines are to be triple compound, with four cylinders working four cranks. They will probably indicate 33,000 indicated horse power. Accommodation is provided for 700 first and 300 second class passengers and about 400 emigrants, and all the arrangements worked out in the plans are far ahead, as far as regards luxury and comfort, of anything yet produced. The plating of the ship is carried up to the promenade deck, which runs from end to end, and a width of about 20 ft. on each side is left for walking. On the promenade deck are twelve machine guns, and in other respects the vessel is made suitable for an armed cruiser.

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VALLEY'S RAILROAD FOR LUMBERMEN, ETC.

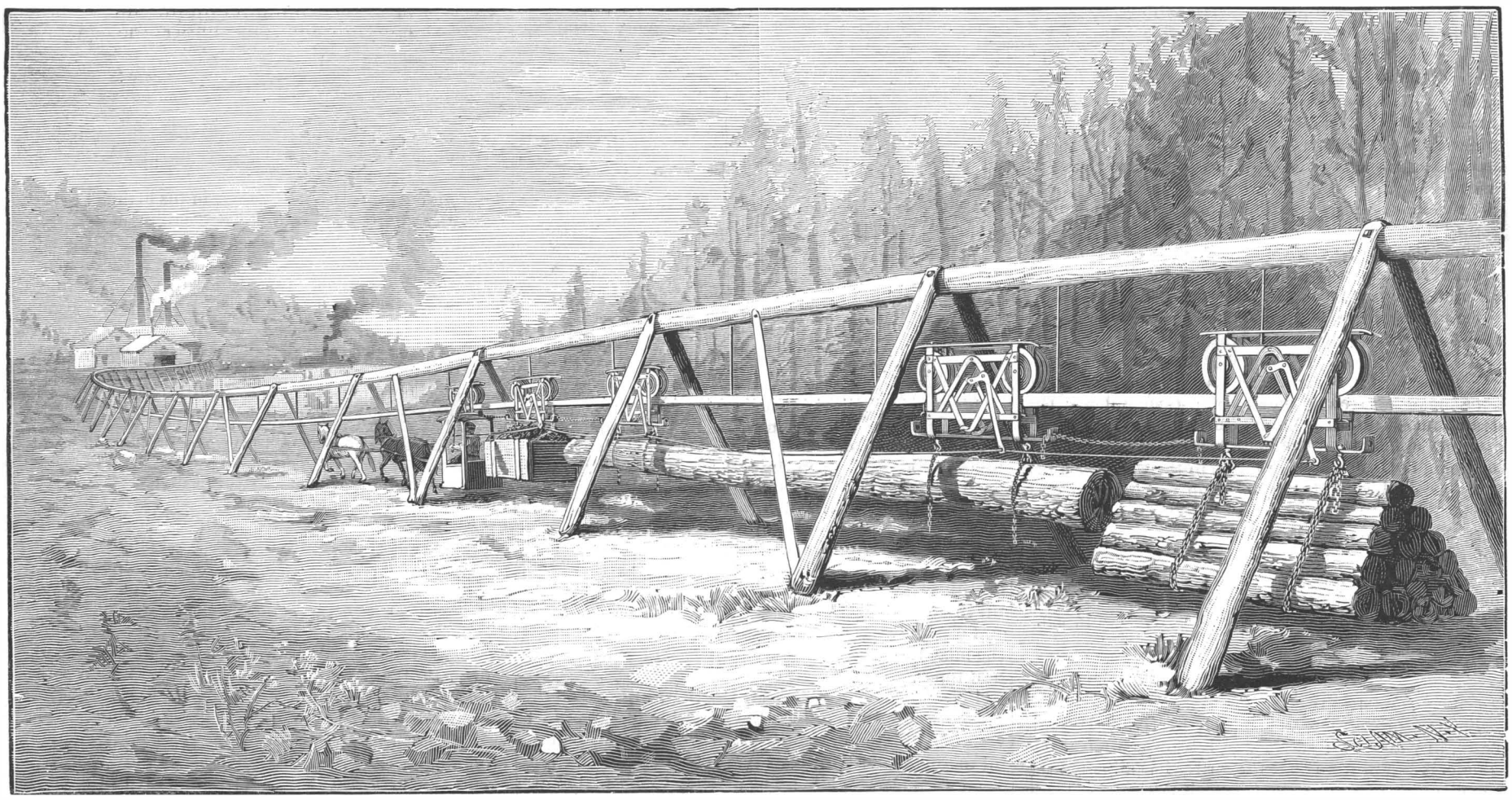
A railroad of inexpensive construction, and which is designed to be strong and durable, and especially adapted for use in timber lands for getting out logs, or in the neighborhood of mines, for transporting coal, ores, or refuse, is shown in the accompanying illustration. This road, with a carriage particularly designed for use therewith, having a novel and effective style of brake, forms the subject of five patents issued to Mr. John N. Valley, of No. 643 Jersey Avenue, Jersey City, N. J.

The single rail or track of this railroad is supported by hangers from overhead longitudinally-ranging stringers, which are themselves sustained by downwardly diverging pairs of posts or struts set into (or on) the ground, the tops of these posts being let into opposite sides of the stringer, where they are fastened by a bolt. Where the road curves more or less sharply to the right or left, the adjacent ends of the stringer sections are pivotally connected by means of a pair of links and bolts, but where the road is ordinarily straight, the ends of the sections are simply halved and bolted together. The hangers pass centrally through the timber sleeper, each side of the top outer edge of which constitutes the track, and the lower ends of the hangers are screw-threaded, and carry nuts, on which the sleeper rests. This allows the sleeper to be readily set higher or lower on any particular hanger, to regulate the level of the sleeper and the track rail, by simply screwing the hanger nuts up or down. The hangers are also preferably connected to the stringer by screwing their threaded upper ends into the stringer, thus allowing the hangers to be adjusted higher or lower in the stringer, to supplement the vertical adjustment of the sleeper and rail by the hanger nuts, to level or grade the track.

The carriage designed for use with this railroad is U-shaped in cross section, with upwardly ranging sides supporting the wheels at their upper ends, the frame substantially consisting of two yokes braced and connected together. At or near the top the yokes are connected by side bars bolted or riveted to the legs, and near the bottom they are connected by a tie band extending horizontally entirely around the carriage. At each side the yokes are further braced by two oppositely disposed V-shaped braces, while from near the bottom of the carriage a cross brace extends downwardly and inwardly toward the center, where it has a horizontal central part on which is bolted a longitudinal drawbar, the upturned ends of which extend beyond the carriage and are adapted to act as buffers, while they are provided with eyes to receive coupling bolts, by means of which several cars may be connected together. To the bottom of the carriage two or more depending hooks are secured for suspending the load, these hooks having each a threaded shank to receive a nut by which the hook is secured in place. At the top of the carriage are longitudinal bars, bent downwardly and outwardly at their ends, and, should the carriage become slightly displaced laterally, the curved ends of these bars will strike the hangers or suspension rods, thus righting the carriage on the track. The axles of the wheels are in the form of bolts, in order to be readily removable for reversing the wheels, as may be desired where the main line of a track is supplied with metal rails, consisting of flat bar iron attached on each side of the top outer edge of the sleeper. In this case the wheel flanges will travel on the inside of the rails, while, with the sleeper alone constituting the track, as would be the case in branch tracks or where the work was light, the wheel flanges would be on its outer side.

This carriage is also provided with a special form of brake, in which the brake shoe extends longitudinally just beneath the track, at the inside of the carriage, and is suspended from a brake lever fulcrumed on the V-shaped brace of the carriage. Vertically extending diverging arms, formed integrally, are bolted to the shoe at their lower ends, the upper end of the arms, at the point of union, being pivoted to a bent portion of the brake lever. The brake shoe is angular, and is adapted to bear against the bottom and one side of the track sleeper. On the inner side of the carriage, opposite the brake shoe, is a beveled surface, whereby, as the brake lever is thrown to bring the shoe against the bottom of the track, the beveled surface of the carriage will cause the shoe also to move laterally, and press likewise against the side of the track.

The construction covered by these several patents admits of considerable modifications, as may be called for on account of the varying nature of the ground in different sections, or the amount and kind of service required. The structure and cars may also be made of metal and wood in such manner as to be serviceable for the transportation of passengers.



AN ELEVATED RAILROAD AND LOG CARRIER FOR LUMBERMEN'S USE, ETC.

Alaska.

The timber line on the mountains seems to me to be remarkably high, and the shrubbery, grasses, and mosses occupying still higher regions afford splendid pastures in the summer for moose, caribou, ibex, and mountain sheep, and in the winter even supply food for immense herds of wild reindeer.

The river valleys of Alaska are usually wide and rolling, and covered with interminable forests of birch, spruce, willow, poplar, cottonwood, and some of the smaller varieties of needlewood. Throughout these primeval timber lands the soil consists in the summer time of a thick, spongy layer of moss and lichens fairly soaking in moisture. The closely woven vegetation has for centuries made it impossible for the sun to dry out this peaty soil, and the moisture retained makes the land unfit for agriculture. I have found in several instances, however, large tracts of timber land through which forest fires have raged, and in which the peat has been burned out. The ashes and the sandy soil under the moss and lichen, mixed through the ages with rich humus from decayed vegetation, in such cases, produced perfect tangles of wild flowers. The density and variety of Alaskan vegetation, its quantities of wild flowers and berries, argue in favor of agricultural possibilities. It is true that from two to five feet below the surface one may strike at all times a layer of solidly frozen ground, yet the same fact has been shown to obtain with the great wheat fields of Manitoba and the Northwest Territory. Only potatoes and turnips have been tried in Alaska, and both have yielded remarkable crops. I was surprised not to find anywhere among the white traders and missionaries any hot beds, for the use of which the climate seems to be particularly adapted. The summer season is short in months, but in point of hours of sunshine it is equal to about six months of our summer. By the gift of the midnight sun, Providence has intended at least a partial equalization for the benefit of the poor Alaskan.

The tundra land is a dreary moor which frames the western shore of Alaska. It consists of deposits made by the great streams, the Yukon, Kuskokvim, and Nushagak, through the ages. All these streams are full of driftwood and sediment, and are gradually building new territory out into Behring Sea. The tundra is, therefore, practically delta land, consisting of a stratum of sunken and interlaced water-logged driftwood, covered with silt or clay on which a layer of peaty vegetable remains, forming a foundation for the endless moss. Throughout this immense plain of "made" land there are pools and lakes and dead rivers which are inhabited during the summer by millions of ducks, geese, and cranes, who have developed in that regions the great breeding ground of the world. The numbers of these aquatic birds which are seen on a summer trip through the tundra are simply beyond comprehension. I myself have seen the sky as black with geese as if a swarm of locusts were descending, and I have also enjoyed the peculiar sport of hunting wild geese with a club. The tundra moss is liberally mixed with a moss-like plant, bearing a blue berry, which geese and ducks consider a rare delicacy. It seems to me that some profitable industries might be derived from the existence of these huge breeding grounds.

Everywhere in Alaska is secured every year a magnificent output of land furs, not to be surpassed. There are mink, marten, land otter, white, red, black, and silver-tipped foxes, beaver, porcupine, Arctic hare, black, brown, red, and silver-tipped bear, gray timber wolves, marmot, ground squirrel, muskrat, ermine, wolverine, and probably some varieties have been omitted in the list. The annual catch of seal and sea otter is generally known. The salmon canning industry of Alaska is being rapidly developed, there being over twenty established canneries in the territory at the present time. Yet there are many other pursuits which may be and which will be followed to advantage.—*A. B. Schanz, in Frank Leslie's Illustrated Newspaper.*

The Electric Light in Dentistry.

We now have the electric light to aid us in our dental operations, and I find by its use I can discover imperfections in cavities I have prepared that had previously escaped my attention. Why? Because the electric light gives a paler white light, and it is more intense than daylight. This is particularly so in that form of decay known as the white decay. You may prepare the cavity with the ordinary care, having it seemingly perfectly dry, and a magnifying glass will show you no imperfections, but with the aid of the electric light you find them.—*Dr. Pruyn.*

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SCIENCE IN THE THEATER.

Stage mounting has now become one of the most complex and refined of arts. The spectator, in fact, is no longer satisfied, as of old, with a vain illusion that his imagination is called upon to complete, but he requires a semblance of reality capable of giving him the sensation of the genuine thing, and, naturally, all hands, the impresarii, machinists, scene painters, etc., put their wits to work (in most cases with success) to gratify his taste. Each new spectacular piece reveals to us some novel innovation, and, in truth, it is an occupation not without interest or utility to study the modifications and improvements that have been made in time in the same scenic effect.

Let us take, for example, the representation of fires, in the theater. Formerly, as in Mignon, or in the Prophet, some flames of lycopodium and some red Bengal lights sufficed to satisfy everybody. Great improvements have been made since, and in recent years the skillful stage mounters of the opera house have twice shown us (first in Sigurd, and but a few days afterward in the Magian, Mr. Massenet's new opera) conflagrations that have been improved to such a degree as to be capable of vying with real fires, as far as effect is concerned. In this regard, the setting of the Magian is particularly remarkable. We are at the last act of the drama. The temple of Djahi is in ruins. The Turanians have burned it. Alone stands intact the triumphant statue of the goddess, before whom, like smoke of incense, rise puffs of bluish vapor from the rubbish. The Magian Zarastra contemplates the pile of debris with horror, and near him stands Anahita, the queen of Turan. Meanwhile, the priestess of the temple, Varedah, mortally wounded and lying prone upon the earth, revives and, seeing Zarastra triumphant near her rival, invokes the Djahi in a burst of fury. The latter obeys her voice. The fire, which is still smouldering under the ashes, breaks out again. At first, the smoke becomes more intense, and its spirals, on rising in the air, become tinged with red. Then the flames soon reappear along the cornices that are still in place, the statue gives way, the fire extends by degrees, and the stage is soon nothing but an immense glowing brazier, in which sparks are crackling, flames are flickering and smoke is curling.

Now what is the secret of this wonderful stage mounting? It will be recalled that in Sigurd the effect obtained is produced by jets of steam to which a rose color is given by means of Bengal lights. The steam under pressure enters through large conduits running under the stage and escapes through small tubes soldered to the supply pipes and traversing the stage floor. The maneuver is executed by operating a cock. The inconvenience of the process lies in the loud strident noise made by the steam escaping into the air.

In the Magian, where the orchestra music at the moment of the fire is relatively soft and low, this circumstance would have been most annoying. It therefore became necessary to find a means of producing the steam in abundance, while at the same time preventing noise being made by its escape. The difficulty was happily surmounted as follows: The steam generated by a boiler is here again led by pipes as in Sigurd; but instead of its being allowed to escape through a thousand narrow orifices, it is made to pass into special apparatus—large boxes in the shape of an isoceles triangle connected in pairs at the two extremities of the same supply pipe. These boxes, which are fixed by the apex opposite the base of the triangle, have, at their point of attachment, considerable thickness, which gradually diminishes in measure as the wide part of the apparatus is approached. At the base of the triangle the thickness is greatly reduced, so that the steam, which is distributed throughout the whole extent of the box, escapes without any noise, and throughout its width, through a narrow orifice between the two faces of the apparatus. In the interior of the boxes there are pieces of felt, the principal object of which is to absorb the drops of water carried along mechanically (Fig. 1).

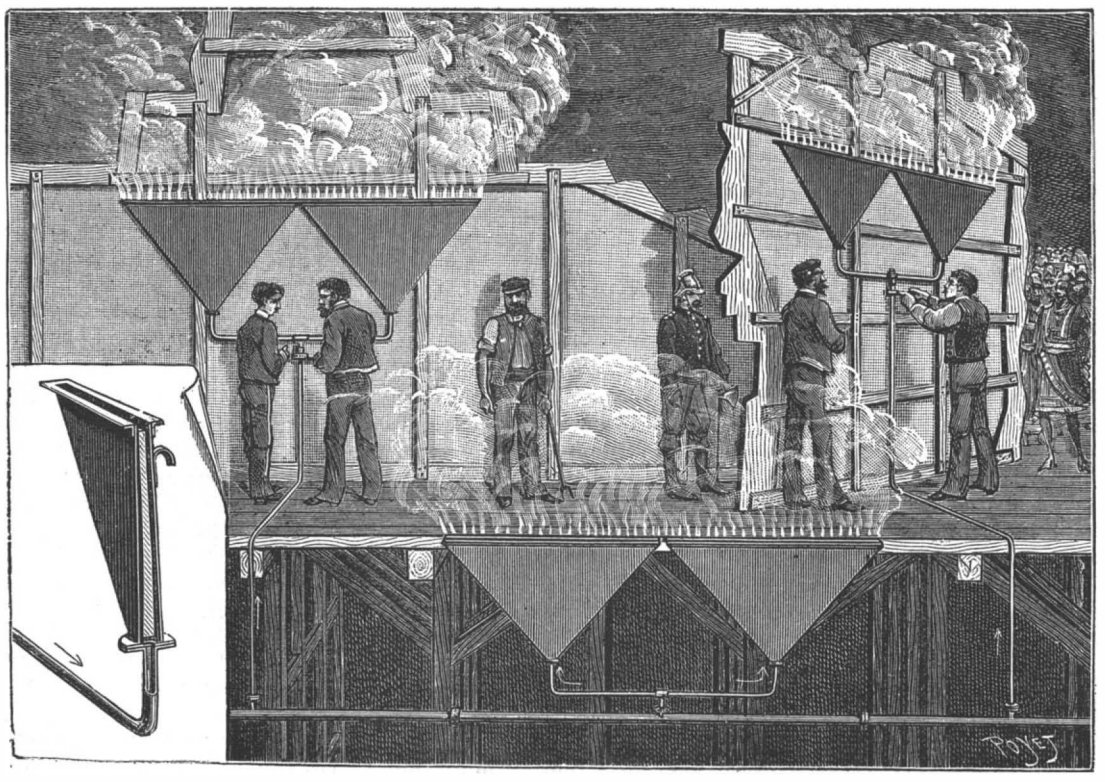

Fig. 1.—APPARATUS FOR IMITATING THE SMOKE OF A CONFLAGRATION ON THE STAGE OF A THEATER.

The advantage of this peculiar arrangement, which, at the opera house, was installed entirely by Mr. David, is that it permits of the disengagement of steam everywhere where it is necessary. These boxes, in fact, are easily manipulated by two men, and hooks fixed to their surface permit of attaching them at will, and in an instant, along a strip light or elsewhere, above the stage or on a level with it. After a simple coupling pipe has been connected with the steam conduit, the apparatus begins to operate.

In the Magian, twenty-nine of these double boxes are employed. Seventeen are distributed over the stage at different points and nearly up to the height of the soffit curtains. The twelve others are beneath the stage

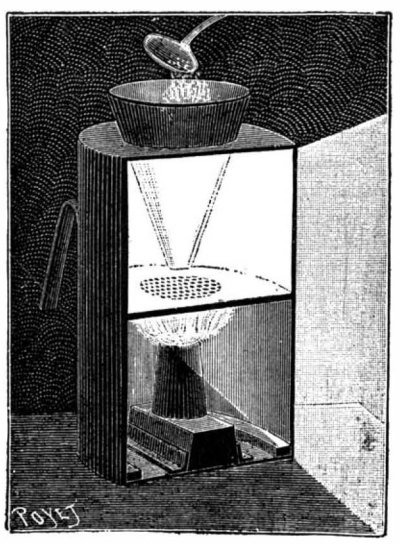

Fig. 2.—APPARATUS FOR IMITATING LIGHTNING.

and the orifice whence the steam escapes and traverses the flooring.

This system of conflagration, the effects of which are heightened by Bengal lights, lycopodium flames, variously colored jets of electric light, and small pieces of fireworks designed to simulate the leaping of the sparks produced by the sinking of the statue, is not absolutely new. It has, in fact, already been employed at Dresden, and in the Theater de la Monnaie, at Brussels, in the mounting of Valkyrie. At Paris, for example, it has been notably improved by Mr. David. At Dresden, in fact, the boxes were of wood and allowed of the spreading of the steam, which soon filled all the parts beneath the stage. They are now made of galvanized iron, and leakages are impossible.

This new method of producing the illusion of a fire is not the only innovation made at the opera house *apropos* of the Magian. The method of imitating thunder has also been improved. In the third or mountain act, we see a terrible storm, the lightning flashes of which are as vivid and blinding as those observed in nature. They are produced in a very simple way, and are due to the sudden combustion, upon a highly heated grille, of a mixture of three parts of magnesium in powder and one part of chlorate of potash (Fig. 2). It is a similar process that is employed by photographers for taking instantaneous pictures at night. Combined with the flames of lycopodium, these magnesium flashes produce surprising effects of realism, and far exceed anything that can be obtained in this direction with the electric spark.—*La Nature.*

A SOCIETY of Philadelphia physicians, recently organized, has for its purpose the discussion of electrotherapeutics and the inducing of qualified practitioners to take up the subject on a scientific basis.

Action of Sulphurous Acid.

The importance of a knowledge of the effects of sulphurous acid on the human organism has been of late very much increased by the frequency with which this agent is now employed for the preservation of wine and vegetables. It is known that after animals have been poisoned by breathing air impregnated with sulphurous acid, the highly irritating properties of the gas are manifested by the injected state of the blood vessels of the mucous membrane of the respiratory tract where the sulphurous acid has come in contact with it, the blood of the viscera being found dark and coagulated. Also that animals that are not killed recover very rapidly, but after a few days show signs of bronchitis and pneumonia and die. The subject has recently been examined by Dr. L. Pfeiffer, who in some experiments employed sulphurous acid in the form of neutral sulphite of sodium, and not in the free state, so as to avoid the caustic action. He found that both warm and cold blooded animals recovered very rapidly from an almost moribund condition, which showed that there must be either very rapid elimination or a chemical change into some harmless substance. Experiments instituted with the object of elucidating this point showed that 96·5 per cent of the sulphite was eliminated by the kidneys as sulphate, the remaining 3·5 per cent only as sulphite. When a large quantity of sulphite had been administered, it was nearly all eliminated in five hours.

Dr. Pfeiffer believes that when vegetable feeders are made to breathe air containing free sulphurous acid for some considerable time a reduction of the alkalinity of the blood is induced. In animals breathing air containing from one to three parts of sulphurous acid per thousand, intense inflammation of the tracheal and bronchial mucous membrane was produced, also inflammatory foci in the tissue of the lungs, the blood in the capillaries becoming black and coagulated. Injections of a 5 per cent solution of sulphurous acid into the stomach set up very extensive and severe gastritis, not only all the coats of the stomach itself being affected, but also the superficial portions of neighboring organs, as the liver and diaphragm, death occurring in from three to five minutes. It is suggested that this rapid and far-reaching action may be due to the disengagement of the gas by the heat of the stomach, so that it diffuses itself much more rapidly than a liquid could do. Dr. Pfeiffer finds that in some wines there is as much as eight parts of sulphurous acid, probably as bisulphide of lime, in 100,000, and that in preserved vegetables, such as are used in the army and on board ship, there is often a very appreciable quantity either free or combined with alkalies, this being especially the case with preserved asparagus.—*Lancet.*

A Plague of Grasshoppers.

Portions of Cheyenne County, Wyom., are covered by grasshoppers. For three weeks they have been hatching out, and myriads cover the prairie for miles just west of First View. A strip of land ten miles wide and extending in a southeasterly direction across the entire county is completely hidden from view by the insects. They meet with considerable difficulty in crossing the railroad, and consequently settle upon the track, causing the wheels of the engines to slip, so that it often requires two engines to pull the trains over these places. The extent of territory they cover is not known, but they are said to extend over all the land between First View and Limon Junction, and as far south as the Arkansas River. As yet they have done no damage to crops or grass, being too young. By the time they are able to fly or damage crops they will be well out of Colorado into Kansas.

A New Gold-colored Alloy.

An alloy of copper and antimony in the proportion of 100 to 6, is made by T. Held, by melting the copper and subsequently adding the antimony, and when both are melted and intimately mixed, fluxing the mass in the crucible, with an addition of wood ashes, magnesium and carbonate of lime, which has the effect of removing porosity and increasing the density of the metal when cast. The alloy can be rolled, forged, and soldered in the same manner as gold, which it very closely resembles when polished, the gold color being unchanged, even after long exposure to ammonia and acid vapors in the atmosphere. The cost of the alloy in the ingot is stated at about 25 cents per pound.

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The Faraday Centenary.

A brilliant audience assembled on the afternoon of June 17, at the Royal Institution, London, to hear Lord Rayleigh deliver the first of the two lectures appointed in honor of the centenary of the birth of Michael Faraday, the second of which, given by Professor Dewar, was to be delivered the following week. The Prince of Wales, president, was in the chair, and there were also present many distinguished people and eminent men of science.

We take the following from the London *Times:*

Lord Rayleigh yesterday performed an extremely difficult task with the mastery that was to be expected from so eminent a physicist and mathematician. It is not easy to talk, before an audience composed in part of the leading scientific men of the day and in part of the interested but entirely ignorant public, about problems which are elementary to the one and hopelessly recondite to the others. It is still less easy to summarize, in a fifty minutes' lecture, the life work of a great discoverer, and to show during the time, by half a dozen experiments, how his discoveries have borne fruit. This, however, was what Lord Rayleigh had to do. He attempted nothing biographical, and did not even try to sum up the effect of Faraday upon his generation. What he did was to take four or five lines of investigation specially dear to the master, and to show how he started on those lines and how his successors have followed him. The beauty of some of the experiments was remarkable, particularly of one where a small electric lamp was made incandescent by being brought, not into contact with, but into the mere neighborhood of a current—an experiment which Faraday himself would have rejoiced to see as the legitimate development of his great discovery of the induction of electric currents. Another showed an aluminum coil leap a couple of feet into the air when the current touched it, others showed the interaction of electricity and light, and these and several more were proved to be directly traceable to Faraday's discoveries of sixty years ago.

The story of Faraday's life has been often told during the twenty-four years that have passed since he died, especially by Dr. Bence Jones and Professor Tyndall. But people's memories are short in these days of crowding events, and we may pause for a moment to recall some of the incidents of that career. He was a man of the people; his father, he once said, was a smith, and he himself, one of a family of ten children, was early compelled to earn his living. He was born in September, 1791, at Newington Butts, and during Michael Faraday's boyhood the home was removed to Jacob's Well Mews, near Manchester Square. Not far off was the shop of a stationer and bookbinder, one Riebau, in Blandford Street, and to him the lad was presently bound apprentice, remaining in that position for eight years, till he was twenty-one. But his tastes lay rather with such science as he could pick up from books than with the art and craft of bookbinding, and at length the opportunity came for him to leave the one for the other.

Sir Humphry Davy's last lectures at the Royal Institution took place in the spring of 1812. A friend had given young Faraday a ticket for them, he went, made notes, and afterward boldly sent his notes to the great chemist, begging that an opening might be found for him to give himself up to science. Davy replied kindly, and before the end of the year Faraday found himself engaged as a laboratory assistant at 25s. a week. The step had been taken. Little by little he conquered Davy's confidence, traveled with him to Italy and Switzerland, learned much from him, and in Geneva gained great profit from the talk and the writings of the elder De la Rive. In 1816 he began to write, and in 1820 we find him contributing a chemical paper to the transactions of the Royal Society.

At the age of thirty, in 1821, he married Miss Sarah Barnard, and at the same time was formally received into the Sandemanian Church, one of those curious sects which in England have for two centuries, at different times, secured the attachment of even eminent men. From the time of his marriage, while still assisting Davy, he made steady scientific progress, and began to take his place in the ranks of the discoverers. In 1825 he discovered the compound called benzol, out of which he might, had he been so disposed, easily have made a fortune. In 1831 came his first discoveries in the world of electricity, to which Lord Rayleigh yesterday confined his attention, and at forty years of age the ex-bookbinder found himself the honored equal of the leading scientific men of the day. This was the year of his discovery of the induction of electric currents, out of which all his other electrical discoveries flowed. Ten years of incessant activity followed, and at the end of the period Faraday's health gave way. But he recovered after a period of rest, and from 1845 to 1867, the year of his death, his activity as a discoverer, experimenter, and lecturer was boundless.

Electricity, magnetism, light, sound—these were one side of the regions that he explored; chemical problems were another, and bridging the two were the quasi-metaphysical problems of the nature of matter and force, which exercised his highest curiosity, as they must always exercise that of the natural philosopher who cares for what lies beyond phenomena. These speculations, however, he did not often introduce into those famous lectures which made and kept him known to so wide a circle. His pre-eminence as a lecturer has passed into history. "Among all lecturers heard by me," wrote the late Sir Frederick Pollock, "he was easily the first. Airy, Sedgwick, Owen, Tyndall, and Huxley belong to the highest order, but there was a peculiar charm and fascination about Faraday which placed him on an elevation too high for comparison with others."

It was the burden of Sir William Thomson's and Sir George Stokes' speeches, which followed the lecture, that Faraday loved science for the sake of science. Had he chosen, he might, as we have said, have made a fortune out of benzol, he might have made several more out of other discoveries. But he felt that he had other work to do. It was a pretty story, that which Sir William Thomson told of him, that long after he had pointed the way toward electric lighting they brought him the Wilde lamp and he said, "I gave it to you a baby, you have brought it back to me a giant." The moment that he made his first great electrical discovery he felt that his path in life was marked out for him, and that he must give up the "commercial" work which till then had been bringing him in an income. He lived simply, with few wants and with no ambitions, except that of penetrating further and further into nature and laying her mysteries bare. Never was a more fruitful investigator, and yet never was there one who thought less of those "fruits" which Francis Bacon was for ever promising to the seekers after natural knowledge. All of us are now enjoying the material results of Faraday's researches. The electric light, the telephone, the Atlantic cable, are the direct outcome of his patient experiments. But it was not of these things he was thinking. His eye was fixed upon truth itself, and not upon the useful results that might come from the knowledge of it. The lesson of his life, indeed, may be almost said to have been expressed in Professor Huxley's words when, after speaking of the things of practical value which the physical philosopher sometimes discovers, he proceeds:

"Great is the rejoicing of those who are benefited thereby, and, for the moment, science is the Diana of all the craftsmen. But even while the cries of jubilation resound, and this flotsam and jetsam of the tide of investigation is being turned into the wages of workmen and the wealth of capitalists, the crest of the wave of scientific investigation is far away on its course over the illimitable ocean of the unknown."

Natural History Notes.

Domestic Serpents.—Rats have multiplied to such a degree in Brazil that the inhabitants rear a certain kind of snake for destroying them. The Brazilian domestic serpent is the *giboia*, a small species of boa about twelve feet in length and of the diameter of a man's arm. It is sold at from a dollar to a dollar and a half in the markets of Rio Janeiro, Pernambuco, Bahia, etc. This snake, which is entirely harmless and sluggish in its movements, passes the entire day asleep at the foot of the staircase of the house, scarcely deigning to raise its head at the approach of a visitor, or when a strange noise is heard in the vestibule. At nightfall the giboia begins to hunt, crawling along here and there, and even penetrating the space above the ceiling and beneath the flooring. Springing swiftly forward, it seizes the rat by the nape and crushes its cervical vertebræ. As serpents rarely eat, even when at liberty, the giboia kills only for the pleasure of killing. It becomes so accustomed to its master's house that if carried to a distance it escapes and finds its way back home. Every house in the warmest provinces where rats abound owns its giboia, a fixture by destination, and the owner of which praises its qualities when he wishes to sell or let his house.

Parasitical Plants.—At a recent meeting of the French Academy of Sciences, Mr. Chatin stated that these classes of plants seriously affect the sap of the trees, etc., on which they exist, destroying certain elements, and, on the other hand, producing new ones. For example, no strychnine is found in the loranthus grown on the *Strychnos nux vomica*, and no quinine in the botanophora of the cinchona; and, in the oak mistletoe, green instead of blue tannin is found. On the other hand, substances are found in parasites which do not exist in the trees on which they are found. Thus, mistletoe contains lime, and the dodder produces yellow and red coloring matters. In the broom-rape of hemp and milfoil a blue color is found; in that of the horseshoe vetch, a rich sulphur tint; and, in the broom-rape of thyme, an amethyst shade. The mistletoe and most other parasites contain fecula, which penetrates to the fiber of the wood. In short, all these matters are formed by the parasitical plants themselves.

The Chinese Alligator.—Two examples of the Chinese alligator have just reached the Zoological Gardens. They are the first that have ever been exhibited there alive. The alligator is so distinctively an American animal that the proof, so recently as 1879, of the species in China was extremely interesting. Nevertheless, the Chinese classics contain numerous references to the creature, and even pictures, which could be easily recognized as being a crocodile of some sort. It is to be hoped that the specimens at the Zoo will bear out the notion of the extreme longevity of the reptile. Its name is apparently used in certain parts of China in the same sense as Methusaleh in this country. Marco Polo wrote about this animal and recommended its gall as an excellent remedy for the bite of a mad dog and for various other complaints, so that it seems to have been the mediæval equivalent of some of our much advertised remedies of the present day. Curiously enough, the beast is even now made use of in Chinese medicine.

Preference of Birds for Drab Nests.—Dr. C. C. Abbott says that in experimenting on the intelligence of birds he placed a number of pieces of woolen yarn—red, yellow, green, purple, and gray in color—near a tree in which a couple of Baltimore orioles were building their nest. The pieces of yarn were all exactly alike except in color. There was an equal number of threads of each color, the red and yellow being purposely placed on top. The birds chose only the duller colors, taking all of the gray and a few threads of the purple when the nest was nearly done.

Not a single thread of the red or bright yellow was touched, the birds seeming to instinctively know that such loud colors would make their domicile too conspicuous. Again he experimented by girdling the branches upon which nests were located, causing the leaves to shrivel and blow away. Although they had laid their eggs, the birds invariably left their nests. If the nests contained young when the leaves dried up, notwithstanding the exposure they would feed the little ones until they were able to take care of themselves.

The Starch of Plants.—It is generally believed that after the fall of leaves the reserve tissues of ligneous plants remain filled with starch until spring, the epoch at which this substance emigrates in order to serve in the evolution of buds, in the development of the root and the formation of a new layer of wood. The hibernal period is consequently considered that in which the amylaceous reserve is most abundant. It results from the researches of Mr. Emile Mer that such is not the case, and that in the vegetation of ligneous plants there occur two acts that up to the present have passed unperceived—one, a resorption of starch at the end of autumn, and the other a genesis at the beginning of spring, each of them having a duration of from six weeks to two months. It hence follows that winter, far from being the season during which the amylaceous reserve is the greatest, is precisely that in which it is the least.

How Animals Imitate the Strategy of Man.—Indian wolves have been seen to leave some of their number in ambush at points on the edge of the jungle, while others drove in antelopes feeding in the open ground beyond. But wolves, as a rule, hunt alone or in families, except when pressed by hunger. Wild dogs, however, habitually combine to hunt, and Baldwin, in his "Game of Bengal," mentions a case of four or five martins hunting a fawn of the "muntjac" or barking deer. But in real military organization and strategy, monkeys are far ahead of all other animals, and notably the different kinds of baboon. Mansfield Parkins gives an excellent account of the tactics of the dog-faced hamadryads that lived in large colonies in the cracks in the cliffs of the Abyssinian mountains. These creatures used occasionally to plan a foraging expedition into the plain below, and the order of attack was most carefully organized, the old males marching in front and on the flanks, with a few to bring up the rear and keep the rest in order. They had a code of signals, halting or advancing according to the barks of the scouts. When they reached the cornfields, the main body plundered while the old males watched on all sides, but took nothing for themselves. The others stowed the corn in their cheek pouches and under their armpits. They are also said to dig wells with their hands and work in relays. The Gelada baboons sometimes have battles with the hamadryads, especially when the two species have a mind to rob the same field, and, if fighting in the hills, will roll stones on to their enemies. Not long ago a colony of Gelada baboons, which had been fired at by some black soldiers attending a duke of Coburg-Gotha on a hunting expedition on the borders of Abyssinia, blocked a pass for some days by rolling rocks on all comers. This seems to give some support to a curious objection raised by a Chinese local governor in a report to his superior on the difficulties in the way of opening to steamers the waters of the Upper Yang-Tse. The report, after noting that the inhabitants on the upper waters were ignorant men who might quarrel with strangers, went on to allege that monkeys inhabited the banks, and they would roll down stones on the steamers. "The last two facts," the report added, "would lead to complaint from the English and embroil the Celestials with them, especially if the men or the monkeys kill any English."

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PERMANENT STEAM ENGINE INDICATOR.

In describing the general principles of the permanent indicator of Mr. Perry, we have shown the difficulties encountered in obtaining exact diagrams when the angular speed of the engine is considerable. It is necessary in tracing a good diagram that the duration of the oscillation of the indicator should be less than one-twentieth of the duration of a revolution of the machine. At one-fifteenth the tracing becomes indefinite and indistinct, at one-tenth it is absolutely impossible. The system of Mr. Perry remedies this defect in the operation of even good indicators, for the card which receives the record, and which comprises the only movable part of the system, has usually a period of vibration of one five-hundredth of a second.

It is possible, therefore, to procure correct diagrams with a engine that has attained an angular speed of 1,500 revolutions a minute. But since it is possible to employ cards whose period of vibration is only one one-thousandth of a second, and even less, it may be said that in practice there is no speed so great that the diagram will not be accurately traced.

The indicator, shown in elevation and cross section in Fig. 1, consists of a thin box of bronze or brass, closed on one side by a thin sheet of steel, D. A disk used for ordinary pressures does not exceed two kilogrammes to the square centimeter to three centimeters of diameter and 0·4 mm. in thickness. For more sensitive work folded disks may be used, but they are more expensive. The plane disks are sufficiently sensitive for ordinary work. When the indicator box is connected with the cylinder of the engine, it is inflated more or less according to the internal pressure. The degree of displacement is considerably increased by putting on the disk, midway between the center and the edge, a small mirror, B, similar to those that are used in electrical laboratories for measuring displacement by reflection. The mirror is mounted on a screw which enables it to be rapidly attached to or removed from the disk. The ray of light from an ordinary oil lamp which falls on the mirror, and is reflected on a sheet of white paper, will trace a path exactly similar to an indication a meter in length.

In this way a diagram of 5 or 10 centimeters may be obtained.

If a lens and a magnesium or oxhydrogen lamp is used, the screen may be placed 12 meters away, and a diagram 2 meters high may be procured without difficulty. The extremity of the arm, F, receives, through a system of levers properly arranged, a slight oscillatory movement synchronic with the piston, and in a direction perpendicular to that of the luminous ray produced by the displacement of the disk. It is easy to understand that the combination of the two movements reproduces exactly the diagram of the engine. New and interesting though the discovery is, it is not necessary to have recourse to a photograph in order to preserve the diagram thus procured. Even at a speed of 60 revolutions the ray leaves its impressions on the retina long enough to enable the observer to trace a diagram on the screen with a pencil. In order to determine the scale of the diagram, the chamber, A, of the indicator is first connected with the atmospheric pressure. A straight line is thus obtained corresponding with atmospheric pressure.

Then the chamber is put in direct communication with the boiler, and a second line is obtained parallel to the first, which defines the height that corresponds to the full pressure furnished by the boiler and indicated by the manometer, at the time the experiment is made. The diagram being thus outlined, the indicator is connected with the cylinder, and the real diagram is obtained. When the engine has attained a speed of 250 revolutions the diagram takes the form of an absolutely continuous line, and it is difficult for even an inexperienced person to make a mistake which exceeds one in one hundred in making a tracing with a pencil. The diagram is thus visible like a black line in the middle of the luminous line which has been traced by the indicator. With an ordinary petroleum lamp a diagram 12 centimeters in width and 10 centimeters in height is perfectly visible, even in a light room. In case the ray is projected into a dark space, it becomes very brilliant, and produces a particular impression on all persons who are in the habit of studying and analyzing similar indications.

Fig. 2 shows the indicator of Mr. Perry mounted on a little steam motor constructed by the students of Finsbury College. The ray of light proceeding from the petroleum lamp passes through the hole, A. B is the indicator, the mirror of which reflects the image on the screen, C. Mr Holland succeeded in making photographs of these diagrams by simply surrounding the screen with a box. Excellent proofs were obtained after a minute's exposure with an ordinary petroleum lamp, and only a few seconds are required when a magnesium ribbon is burned behind the opening in place of the lamp. Mr. Perry prefers to use the dark room, not only for taking the photograph, but for drawing the diagram with the pencil, by applying a piece of tracing paper against ground glass. Fig. 3 shows the reduction of the two diagrams thus obtained by the little engine of Finsbury College. One of the diagrams, No. 1, is traced at the speed of 200 revolutions a minute, the other, No. 2, at 500 revolutions.

With an ordinary indicator, it is necessary to stop

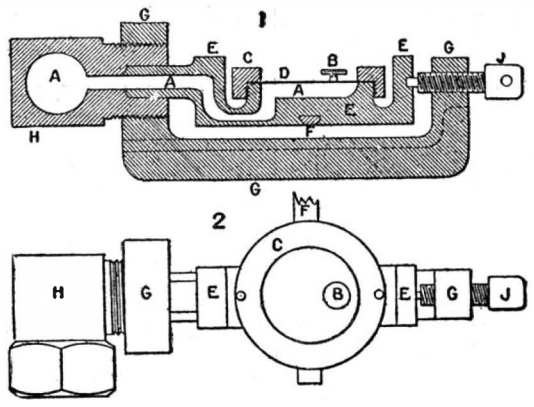

Fig. 1.—A GENERAL VIEW AND CROSS SECTION OF THE INDICATOR.

A, steam chamber; B, mirror; C, frame for holding disk D; E, oscillating frame; G, stationary frame; J, thumb screw; F, lever attachment for oscillating the frame E.

the registering cylinder and change the sheet of paper every time a diagram is made. Here the diagram is continually visible, and it is possible to follow every change of pressure, speed, or load. The permanent steam engine indicator of Perry is specially desirable for use on locomotives and on steam vessels, because it

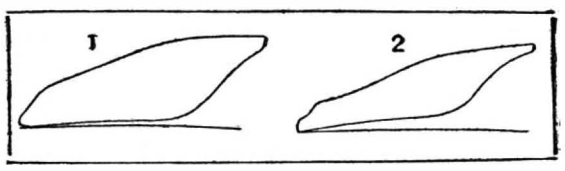

Fig. 3.—DIAGRAMS REPRODUCED FROM CRAYON DRAWINGS.

1, motor making 200 revolutions; 2, motor making 500 revolutions.

furnishes the engineer, at each instant, with a perfect indication of the pressure reached in his engine. It is equally desirable for use with pumps, and in various other machines in which fluids are used. Mr. Ayrton has already stated it would be possible to modify the apparatus in order to trace the form of the current produced by machines which have altenating currents. The principle of optics of Lissajous, which has not heretofore been applied in any other way than in the study of acoustics, can then render great service in the study of an industrial apparatus, as well as in other lines of scientific research. We owe many thanks to Mr. Perry for having produced the ingenious indicator which we have just described, after a communication made by the author to the Physical Society.—*E. Hospitalier, in La Nature.*

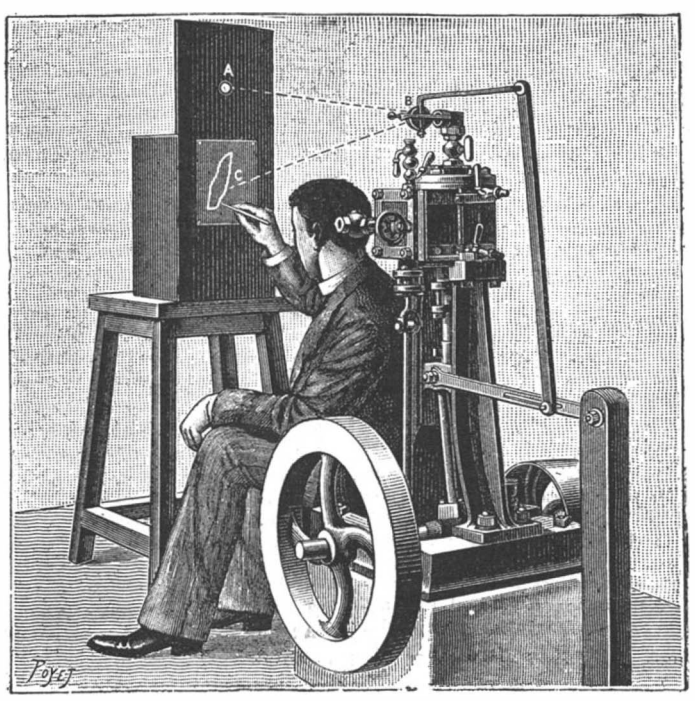

Fig. 2.—HIGH SPEED PERMANENT INDICATOR OF MR. J. PERRY.

A CORRESPONDENT places the address of a letter on the back thereof, the writing being across the folded parts of the envelope. He suggests this plan as an effective method of preventing the illicit opening of letters by steaming, etc. For the intended purpose the suggestion appears to be a good one.

New Class of Sugars.

The discovery by Tollens and his pupils of the existence of a class of sugars containing only five atoms of carbon in the molecule instead of six raises rather an important question as to our methods of food analysis. These *pentaglucoses* have not been shown to exist ready formed in any of our commonly used feeding stuffs; but they are produced in greater or less quantity when such stuffs are subjected to the action of dilute acids, the process always adopted for inverting cane sugar before its determination by Fehling's solution, and sometimes for a similar determination of starch. The proximate constituent of the plant which undergoes this change into a pentaglucose is probably a gum; for gum arabic is the best source yet discovered for one of the two members of the group at present known. This is *arabinose;* it sailed for some time under false colors, being generally regarded as a true glucose, or six carbon atom sugar, and it is only recently that its true character has been ascertained. The other pentaglucose is *xylose*, obtained most abundantly from the bran and other woody tissues. Both reduce Fehling's solution.

From what has been said it will be evident that the presence of these gums in a vegetable product used as a food must give rise to errors in the determination of the true sugar, and sometimes of the starch in that food. Now this error would be unimportant if it could be shown that these gums were of equal nutritive value with sugar or starch, but this has not been shown. On the contrary, all evidence is at present the other way, for it is probable that the splitting up of the gum into its pentaglucose would take place in the stomach, and there is no ground for the assumption that the pentaglucoses are of equal or similar nutritive value with the hexaglucoses. Neither of the pentaglucoses can be fermented with yeast.

Attention has recently been called to the wide-spread existence of the substances which give rise to the pentaglucoses by W. E. Stone. By taking advantage of the ease with which these bodies can be decomposed with the formation of an easily determinable substance called *furfurol*, he has found that after the gums, brewers' grains contain the largest quantity—about 12 per cent. The straws come high in the list, then Hungarian grass and "corn stover," as the Americans call their maize offal. Timothy hay and linseed meal are not far behind, while, on the other hand, corn meal (presumably maize) and cotton seed cake contained none.—*Chemical Trade Journal.*

The Weather Bureau.

The signal service corps of the army was relieved, on July 1, according to the provisions of an act of Congress, of the duty of furnishing the public with the daily weather reports, and this work was turned over to the Department of Agriculture. Gen. Greely is succeeded as chief of the bureau by Prof. Mark W. Harrington, professor of astronomy in the University of Michigan, at Ann Arbor, and editor of the *American Meteorological Journal.* He is about 43 years old, and is regarded as an accomplished student of meteorology and climatic problems. He has had considerable correspondence with the department about climatic matters in relation to agriculture, having prepared a bulletin on the subject, which is about to be published by the forestry division of the department. The intention of Congress in making the change was that the work of the weather bureau might be extended beyond its present scope in every way where such enlargement could possibly be of benefit to our agricultural interests. Secretary Rusk says the work of the meteorological service of the United States government must go far beyond the mere forecasting of the weather, and be so extended as to include a thorough systematic investigation into the climatic conditions of the various sections of the country, in order that a full knowledge of them and of their effects upon plant growth should be available for the farmers.

Whooping Cough.

Common thyme, which was recommended in whooping cough three or four years ago by Dr. S. B. Johnson, is regarded by Dr. Neovius, who writes a paper on the subject in a Finnish medical journal, as almost worthy the title of a specific. During an epidemic of whooping cough he had ample opportunities of observing its effects, and he came to the conclusion that if it is given early and constantly it invariably cuts short the disease in a fortnight, the symptoms generally vanishing in two or three days. They are, he finds, liable to return if the thyme is not regularly taken for at least two weeks. Regarding the dose, he advises that a larger quantity than Dr. Johnson prescribed be taken. He gives from one ounce and a half to six ounces per diem combined with a little marshmallow sirup. He never saw an undesirable effect produced, except slight diarrhœa. It is important that the drug should be used quite fresh.—*Lancet.*

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RECENTLY PATENTED INVENTIONS.

Engineering.

WIND ENGINE. — Samuel Griswold, Davenport, Washington. This invention provides a wheel of novel construction, designed to be cheap and durable, the improvement consisting of a vane casting journaled in a derrick, a wheel casting pivoted in the vane casting upon a horizontal shaft, and the wheel attached to the wheel casting, whereby it can be shifted from a vertical to a horizontal position, and *vice versa*, while in operation, and still impart motion to the sucker rod. This improved construction is designed to afford a uniform rate of speed under varying forces of wind.

Railway Appliances.

STOCK CAR.—John A. Stewart, Mansfield, Ohio. This invention provides a car with removable stanchions so constructed that separate compartments may be thereby conveniently and quickly formed in the car to accommodate one or more animals. Provision is also made for attending to the stock at any time, whether the car is in motion or not, and for the storage of a quantity of food, which may be placed in the storage compartment without disturbing the cattle, while a water trough is provided, adapted to be supplied from stationary reservoirs.

CAR BRAKE ATTACHMENT. — Lincoln H. Raub, South Easton, Pa. A convenient means for setting the brakes by hand, in connection with a safety attachment, and a spring attachment for the brake beam, so that the brakes will not be set sufficiently hard to prevent the wheels from turning, form the distinctive features of this invention. The improvement is designed to obviate difficulties arising where air-operated brakes are also operated by hand, the ratchet wheel and pawl of the hand mechanism being in such cases frequently injured or destroyed, while also preventing the damage to car wheels occasioned by sliding on the track when the brakes operate to entirely prevent the wheel from turning.

Mechanical Appliances.

PLANER CHUCK. — Charles F. Fulmer and William E. Kelvie, Plainfield, N. J. Combined with a rotatable platen securable on a base piece is a jaw with tongues that slide in grooves of the platen, and is actuated by a screw, another jaw composed of a base plate having tongues engaging the platen grooves, while there is a circular boss and two standing bolts, and a jaw piece with a socket in its lower face to fit on the boss of the base plate, and having curved slots through which the standing bolts pass. The improvement affords means for a quick change of adjustment to suit the form of material to be held, either straight or taper, and hold it firmly in position to be operated upon by the cutting tool of the planer.

LATHE CHUCK. — The same inventors have also obtained a patent for an improved lathe chuck, which is so constructed that its jaws may be simultaneously moved or each jaw can be separately adjusted, the chuck being adapted to grip articles of a regular or irregular form. It is a simple, durable and convenient device, the invention providing a novel construction and combination of parts designed to secure great strength and afford special facility for its ready manipulation.

SCREW BEADING MACHINE,—Abraham M. Southard and George W. Smith, Denver, Col. This invention covers a novel construction, whereby the ordinary beader used by tinsmiths is transformed into a machine capable of forming screw threads on the joining extremities of all kinds of light metal pipes or tubing, such as stove pipes, speaking tubes, etc., and all kinds of sheet metal conduits. A pair of shafts, on which is mounted a pair of co-acting bead rolls, are held in a suitable frame, one of the shafts having a threaded portion, while a gauge is slidingly supported between the shafts and has a feeding attachment consisting of a half nut or threaded lug to engage one side of the threaded shaft. The screw bead or thread is formed on the pipe by turning a crank, after the proper gauge adjustment.

CASTING MACHINE. — John S. Griffin, Roslyn, Washington. Combined with a casing is a mould consisting of two horizontal swinging sections hinged together at one end, where it is provided with upper and lower anti-friction wheels, in connection with mechanism for opening and closing the mould This improved casting machine is designed for conveniently and rapidly casting billets, hollow ingots to be manufactured into seamless tubes, and other articles.

RIVETING MACHINE. — Reinhold A. Carl, Hearne, Texas. This invention relates to improvements in machines for driving rivets in leather and other flexible material, providing a machine especially adapted to drive a pointed rivet instead of the ordinary blunt rivet. It has two vertically aligning plungers forced together by a lever mechanism, a sleeve inclosing the lower plunger, above which meet a pair of spring-pressed jaws, a separable burr holder being interposed between the two plungers, while a spring-pressed burr set is mounted loosely on the upper plunger, with a lever mechanism for forcing the set downward and a lever mechanism for releasing it. The machine drives and heads the rivets at the same operation, and without first punching holes in the material.

BRICK MACHINE. — Albert Brooker, Lancaster, Wis. Combined with the supporting frame and a mud box in its upper part is a die having outwardly extending bars working in guideways in the frame, to which weighted levers are pivoted, links connecting the levers with the bars of the die. It is a machine of simple construction, in which the ordinary bottomless mould may be used, and which will deliver the moulded bricks directly upon movable pads, the machine being also provided with a wire cut-off for smoothing the tops of the bricks and separating them from the mud die.

ROOFING SEAMER. — Richard R. Delaney, Charleston, West Va. Combined with a pair of tongs are three jaws, connected with and operated by the tongs, a roller being journaled to one of the jaws, which serves to turn the edge of the seam down, ready to be clamped and finished by the tongs. It is a simple and convenient tool for turning single or double seams, made at a small cost and very powerful, being effective for turning and clamping together the seams of heavy sheet metal like tin, zinc, or galvanized iron.

MACHINE FOR POLISHING COFFEE, ETC.—William P. Clifford, Oskaloosa, Iowa. A shaft carrying a series of opposing arms is held to revolve in a cylinder, the arms consisting of plates radiating from hubs, while pins extend from the opposite faces of the plates, in combination with a tank adapted to contain glazing material, a warming jacket surrounding the tank, and a pipe leading from the tank into the cylinder. The machine is of simple and durable construction, and may be used in connection with a coffee cleaner and grader or independently, for polishing and glazing coffee or any material requiring such manipulation.

SEWING MACHINE. — Henry H. Fefel, New York City. Combined with the needle, feed, and main shaft of the machine, with a stitch hook having an upper and lower bill poised in the center on a pivoted crank, is a rotarily reciprocating double crank shaft, the stitch hook being attached to one of the cranks. The machine is especially designed for making an "overstitch," is simple and durable and capable of high speed, and is designed to lay the threads of each stitch close together and at the proper angle to give the work the appearance of hand stitching. The feed and needle arm motion, the tension and guides and other accessories of the machine, may be of any approved construction.

SCREW DRIVER. — John Q. Day, Red Cliff, Col. The handle of this tool supports a tube having two sets of spiral grooves, the shank extending into the tube being provided with a clutch, and a sleeve having a clutch being mounted to turn loosely on the shank, the clutch engaging the shank clutch, while blocks pivoted on the sleeve engage one set of spiral grooves at a time, and a spring coiled on the shank presses with one end on the latter and with its other end on the tube. The screw driver is actuated by simply pressing the handle when the screw head is engaged, and it is arranged to turn the shank in either direction for driving in or unscrewing screws.

Agricultural.

PLANTER. — Orval E. Baldridge, Illiopolis, Ill. This is a machine of simple construction, intended to be built at a low cost. The drive wheel has an adjustable sleeve on one of its spokes, combined with seed boxes and a centrally pivoted lever, the seed drop bars being pivoted to the lever and held to slide in the boxes, while an arm hinged at one end of the lever has an offset adapted to engage with the sleeve of the drive wheel. The seed may be covered by any of the well known attachments, but preferably by curved blades secured to the rear lower portion of the chutes.

Miscellaneous.

WIND MUSICAL INSTRUMENT.—Harry J. Light, Sedan, Kansas. This invention provides means for changing the pitch or key of this class of instruments, as the clarionet, flute, etc., by the lengthening of the bore by means of rings, to be placed between the several joints of the instruments. The rings or washers are made of bone, gutta percha, celluloid, or other suitable material, and their interior diameters correspond precisely to the diameter of the bore of the instrument. Exterior rings are employed to fill the spaces covered by the extension of the sections, to give the instrument the usual smooth appearance.

GAME ATTACHMENT.—Emma Barker, London, England. This invention provides means for playing an indoor game substantially like lawn tennis, certain attachments being provided whereby the net may be conveniently supported upon an ordinary dining table, and a convenient racket adapted for indoor use. The courts are marked upon the table, across which the net is stretched, and a soft rubber ball is preferably used, the service being delivered underhand, and the ball being struck by a fore-hand stroke at a point beyond the end of the table.

SHOW CABINET.—Robert E. Sherlock, Lethbridge, and Manfred Freeman, Grenfell, Canada. This is a cabinet in which ribbons, laces, and similar goods will be protected from dust and soiling, and be held in such manner that they will be displayed to the best advantage, while they may be conveniently unrolled and measured and as conveniently replaced. Rows of spools are mounted on a series of horizontal shafts, there being on the shafts friction pulleys designed to be readily forced against the ends of the spools. Longitudinally swinging doors are arranged one above the other opposite the spools.

BANJO TAIL PIECE.—Herschel Fenton, New York City. This tail piece is adapted to rock on the upper edge of the clamping hoop, a depending rear limb rocking on the side of the hoop, and having a lug apertured to receive an adjusting bolt. The device affords means to strain the strings in conjunction with the keys, holding the strings off the head skin, and affording means to connect the strings to the cross bar of the tail piece in a manner to avoid chafing of the strings, thus increasing their durability.

TWINE HOLDER.—Charles F. Walters, Prospect, N. Y. This is an attachment for twine holders designed to automatically wind up the end of the twine after it has been used for tying packages, etc. To the holder is secured a frame in which turns a grooved pulley, provided in its hub and rim with opposite openings, a pinion being connected to the pulley and a segmental gear wheel in mesh with the pinion, while a weighted arm is connected with the segmental gear wheel.

GATE. — Jacob W. Miller, Marion, Ohio. This invention relates to farm gates which swing horizontally and are also capable of being raised bodily independently of their swinging motion, to allow hogs, sheep, etc., to pass through without permitting cattle to pass. The invention provides a novel combination of devices for operating the gate, so that when raised it is lifted directly against its weight to throw it against the hinge post, instead of the pull being exerted from the post to raise the gate.

DRAWERS.—Romulus E. Hill, Evanston, Ill. This invention relates to the manufacture also of trousers, overalls, tights, etc., providing a peculiar make at the crotch, whereby the garment is rendered elastic and better adjustable to various strains, thus contributing to the comfort and convenience of the wearer, while greater economy is obtained in cutting and fitting, variations in waist size being obtained without materially altering the pattern of the leg sections.

LAMP.—Edgar J. Bissell, Bartold, Mo. This is an improvement in that class of lamps having a tube for providing a central air draught, an outer tube affording a wick space, while a vertically removable chimney holder on the latter tube has a deflector, and a central rod projecting above the air tube has a shoulder and single spreader disk with aperture receiving the rod and an outer marginal series of apertures, the spreader disk being of greater diameter than the wick tube. The lamp is simple and compact, and designed to give a strong, clear light, throwing out but little heat in proportion to the size of the flame, the outer and inner draughts being combined in such a way as to give a steady vertical flame.

FIRE ESCAPE. — Horrace Mullennex, Alpine, N. Y. This is a device of simple construction, capable of attachment to any building, to be automatically operated by the weight of the descending persons, the rapidity of descent being readily controlled. It consists of a frame in which are journaled drums over which passes a chain carrier to which baskets are attached, friction wheels being carried by the drum shafts, which are mounted in vertically movable bearings, while friction blocks are mounted under the wheels, and springs press the blocks upward.

POCKET CASH REGISTER. — James L. Brown, Brookville, Pa. The body of this device is a flat oblong plate having a dial cash indicator and register at its two ends, and an intermediate slide register. It is designed to be conveniently carried in the pocket to indicate cash on hand and register cash paid out, and to serve as well for a rule, straight edge, and pencil holder. One side edge of the plate is graduated to form the rule, and the pencil holder is attached to the other side.

ELECTRIC POST OFFICE BOX. — Will A. M. Smith and Robert T. F. Smith, Morrison, Ill. Combined with the box is a door with a catch, and arranged to be operated by gravity, the latch which engages the catch having an armature, while an electro magnet within the box is adapted to lift the latch. The box itself is of the usual form and construction, while the push button is preferably located near the desk of the attendant, so that he may release the door and deliver the mail without changing his position, there being as many push buttons as there are boxes, and each push button having the same number as that of the box with which it connects.

CHECK, DRAFT, ETC.—John L. Spalding, Aitkin, Minn. This invention provides for a certain arrangement of figures in table form with indicative marks or symbols attached on the face of the check to be punched, as required, to denote the value of the check, so that its original amount cannot be altered or raised without detection. The invention is also applicable to money orders or other papers in which the amount on the face is checked before delivery to the payee by the punching of figures on the face of the instrument indicative of the amount of the check.

TYPEWRITER ATTACHMENT. — Anna M. Rothert, Brooklyn, N. Y. This improvement consists of a treadle connected by a chain or cord to a lever, the latter being connected to a shaft which has a fixed arm connected with the usual transverse rod connected to the carriage of the typewriter, and adapted to shift the roller platen backward, to cause imprint of upper case capital letters. It is a simple and inexpensive device, which may also be adopted for any use requiring a treadle and a yielding connection therefrom to a movable part.

SUSPENDER BUCKLE. — John T. Brodnax, New Orleans, La. This is an improved device for connecting suspender ends to the suspenders proper, the buckle frame having a transverse slot and upwardly extending openings in its front portion, while the back plate has a web which unites it to the front portion, the clamp having its upper edge provided with a right-angled bar which is slotted to receive the web, and has its lower edge provided with teeth adapted to engage the suspender.

SUSPENDERS.—The same inventor has likewise obtained a patent for improvements in the attachments for connecting the different parts of the suspenders, and for attaching the suspender ends or button straps. The improvement embraces tubular front attachments having a hook, tongue, and cross bar extending across the lower portion of the opening of the tube, with other novel features.

PATTERN FOR VESTS AND SHIRTS.—A third patent to the same inventor provides a pattern in which the suspenders will be located relative to the side and shoulder seams and neck band of the garment, whereby a proper and comfortable fit is insured, whatever be the proportions of the person for whom the garment is intended. The rules of measurement apply to shirts as well as vests, and the improvement relates to former patented inventions of the same inventor for suspender attachments for shirts and vests in which the suspenders are permanently secured to the garment, or arranged in pockets formed therein, and converge to a point on the back.

SASH HOLDER. -- Edward Z. Kidd, Deadwood, South Dakota This is a combined sash holder and lock consisting in an open front casing having inclined slots in its side walls, a roller with trunnions working in the slots, the roller projecting through the open front of the casing when its trunnions are at the lower ends of the slots, with a locking arm or lever movable across the lower end of one slot in the path of one of the trunnions, to lock the roller in its lowermost position. The device dispenses with springs, and is adapted to hold the sash at any desired point when open, locking it when closed.

SKYLIGHT LIFTER AND LOCK. — William Trebilcock, Central City, Col. A notched lifting bar connected to the skylight is arranged for lateral movement in an aperture in a bracket, a locking lever engaging the bar, while a spring-actuated locking bar pivoted to its lower end projects through the bracket to hold the lifting bar from upward movement. This improvement forms a simple and easily operated device to raise and lower the skylight for ventilating purposes, holding it locked in any of its adjusted positions so that it cannot be raised or lowered from the outside.

DECK SUPPORT FOR SHIPS' BOATS. — Cornelis J. Van Sluys, Ymuiden, and Cornelis Steffelaar, Jzn., Velzen, Netherlands. This invention relates to an improved construction of supports arranged to facilitate the rapid launching of the boats, and at the same time providing for them a safe and secure resting place on the deck of a vessel. In the construction side bearings are arranged in combination with intermediate keel bearings, there being a longitudinal screw shaft and connections between the shaft and the keel bearings for raising and lowering them.

HARNESS.—John J. Hardy, Lavonia, Ga. This harness has a combined collar and hames, a cross bar pivoted on the upper part of the collar and elbow levers pivoted on its lower sides, with connections between the ends of the levers and the cross bar, while the traces are secured to the lower ends of the elbow levers, and the ordinary hip and breeching straps are connected by a back strap with the upper hame straps of the collar. This harness is comparatively inexpensive, having less than the usual number of parts, can be quickly put on or taken off, and is designed to be very easy to the horse.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

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JULY NUMBER.—(No. 69.)

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Notes & Queries

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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Minerals sent for examination should be distinctly marked or labeled.

(3149) G. M. asks: 1. Please define "versed sine." A. The portion of the initial radius of an arc which is intercepted between the sine of the arc and the arc itself. 2. Is the amount of variation of a galvonometer needle from the north due to the intensity or to the quantity of the current? A. Intensity and quantity of a current are synonymous. The deviation of a galvanometer is due to the intensity or quantity of a current.

(3150) J. D. asks: Will you please give receipt that will stick muslin to bunting? A. Boil together 2 parts shellac, 1 part borax, and 16 parts of water. The surface must not be greasy.

(3151) J. M. C. asks: Is not the tide of the ocean to the revolving earth as a pendulum is to a clock or as a governor is to an engine? Again, does it not hold the earth in check? In other words, is it not the regulator of the great timepiece? A. We do not see the analogy of your questions. The earth is not a tidal propelling power, like the clock to the pendulum. Nor do the tides govern the speed of the revolving earth like the governor of an engine. The tidal check is compensatory in equivalent opposite effect, and therefore cannot be a regulator of the great timepiece. They are in a minute measure antagonistic to the earth's regularity of motion.

(3152) Several readers ask: What is the difference between a square foot and a foot square? A. There is no difference in area or quantity of surface, but there may be a great difference in the shape. A foot square must be a rectangular surface having 4 equal sides 1 foot long. A square foot may be a surface 6 inches wide and 2 feet long, or any shape containing a square foot.

(3153) W. L. G. asks: 1. Will you kindly give me a few points in regard to the manufacturing, on a small scale, of nitrous oxide (laughing) gas? A. It is made by heating pure ammonium nitrate in a retort. The gas evolved must be passed through water and collected over warm water. There is no difficulty in making it, provided the original nitrate is pure. 2. Is it true that the nitric oxide is now used as a successful substitute for anæsthetical purposes? A. We never heard of such use, and do not see how it could be successfully carried out.

(3154) C. E. A. S. writes: I see in the daily *Sun* that Professor R. O. Doremus took ink from paper by the use of hypochlorite of sodium and sulphuric acid. Can you tell me the parts, and if it is the best ink eraser and the quickest? A. Such mixture would answer for most inks. Javelle water is also to be recommended. Use a little acid only. Oxalic and tartaric acids mixed and dissolved in water may be used.

(3155) Subscriber asks: How many degrees of heat are required in an ordinary core oven for a foundry? Can a sufficient heat be made with steam pipes at 80 pounds steam pressure? A. 240° Fah. are required for a core oven. You can obtain this with sufficient pipe at pressure stated.

(3156) R. P. writes: I observed a man cleaning a papered ceiling a few days ago. He used apparently a ball of ordinary bread dough, but as the work was being done rapidly and easily, I supposed there was some chemical used in the composition. The paper was brought out as bright as new. Will you kindly inform me through your valuable paper what composition will do this work? A. No chemical is to be advised for cleaning wall paper. Try a ball of bread crumb.

(3157) F. W. M. asks for the best preservative preparation to use on a Spanish cedar skiff to retain its natural grain and color. A. Raw linseed oil, to be followed after drying by a thin flowing coat of spar varnish. Do the varnishing on a hot day.

(3158) E. D. asks: Can carbon, being wholly burnt out of steel, be renewed? If so, how? How do you harden in oil? What allowance is to be made for expansion in tempering? A. When carbon is burned out of steel, it is past recovery for use as a cutting tool, unless it can be recarbonized and very much drawn down to fine the grain, which becomes coarse and crystalline by burning. Harden in oil the same as in water. Change of size by hardening depends entirely upon the shape of the piece as well as the quality of the steel and heat required to harden. Experience with special work is the only guide.

(3159) C. A. C. asks for a receipt for cleaning marble headstones that have been blackened by age and from trees, one that will not leave the stone yellow; also one for granite curbing. A. Cover the soiled part with a paste of quicklime moistened with a strong aqueous solution of sal soda for several hours, then remove the paste, wash the parts thoroughly, and polish if necessary.

(3160) J. S.—If the indelible ink was made from silver nitrate, the stains can be sometimes removed by moistening them with a brush wet with potassium cyanide dissolved in water, then wash the fabric well. Also try a solution in water of bichloride of mercury. Both are very poisonous.

(3161) H. M. R. asks: I would like to know if there is any other way of cutting ice than with an ice plow? If so, what kind, and where? A. Ice-cutting machines consisting of circular saws operated by steam power have been illustrated and described in SCIENTIFIC AMERICAN.

(3162) E. M. C. asks: Can any portion be removed from the center of a round bar of metal and leave the bar stronger than it was before the portion was removed? Or can a hollow rod be made stronger than a solid one of the same dimensions and same kind of material? A. No.

(3163) F. C. D. asks: Kindly give me a receipt for flavoring various brands of cigars? A. Use any of the following: Ambergris, benzoin, musk, oil of bergamot, oil of lemon, tonquin beans, vanilla beans, oil of lavender.

(3164) F. W. C. P. asks: Will you please state which side of a belt should run on the pulley, the smooth or rough? A. A belt pulls the best with the smooth or hair side next the pulley. Common practice is the other way.

(3165) F. W. V. says: I have a ranch here, at Colton Station, Nebraska, of 3,000 acres, 2,000 of which I want to water so as to raise hay. I would like to know what would be my cheapest way to raise water 50 feet for this purpose, and what kind of power would be required, and what it would cost. There is water enough to be had. The Large Pole Creek runs through 600 acres, but it does not reach the 2,000. The water lies near the surface. Irrigated land here produces 2 tons to the acre. A. If you can get a water fall, a wheel and pumps will be easiest and cheapest to care for, but would require a large storage reservoir somewhere on the higher part of the ranch, so that a small wheel or power constantly running would do an average work. If water power cannot be had, wind mills or steam pumps would next be in order. Windmills require no fuel and are easy to care for. They can be put in various places and be made to lift by stages from one canal to another and save pipe laying.

NEW BOOKS AND PUBLICATIONS.

HENDRICK'S ARCHITECT'S AND BUILDER'S GUIDE AND CONTRACTOR'S REFERENCE DIRECTORY OF AMERICA, FOR THE YEARS 1891–92. New York: Samuel E. Hendricks & Co. Pp. 490. Price $5.

THE "ELECTRICIAN" ELECTRICAL TRADES DIRECTORY AND HANDBOOK FOR 1891. London: The *Electrician* Printing and Publishing Co. 1891. Pp. 729, cxix. Price $2.

The advertisements of leading electrical businesses make up a large part of this volume, and will be found a not uninteresting part of its contents. An immense number of addresses of electrical lighting and power stations all over the world form one part. Biographical notices of men distinguished in the electrical field with portraits form another portion. The portraits accompanying the biographies are worthy of special notice. This portion of the book alone is of value not easily estimated.

HANDBOOK OF NATURAL PHILOSOPHY. By Dionysius Lardner, D.C.L. Electricity, magnetism, and acoustics. Edited by George Carey Foster. London: Lockwood & Co. 1891. Pp. xix, 442.

A TREATISE ON THE CALKINS STEAM ENGINE INDICATOR. New York: E. & F. N. Spon. 1891. Pp. 114. Price $1.50.

Although this work is to a certain extent a treatise on a special make of indicator, it will be found of value by all engineers. It contains, in addition to a description of the special instrument to which it is dedicated, a large amount of general information and quite an extensive series of tables. A special planimeter is described, to be used for measuring indicator diagrams.

THE CLEANING AND SEWERAGE OF CITIES. By R. Baumeister. Adapted from the German, with permission of the author, by J. M. Goodell. New York: *Engineering News* Publishing Co. 1891. Pp. vii, 281. Price $2.50.

The subject of sewage disposal as treated in this volume is given largely from the European standpoint. It therefore has a special interest to the American engineer as showing how Continental authorities and engineers deal with the vexatious cloacine problem. The subjects of general systems of sewage, its purification, and of general municipal and domestic sanitation, including the earth system, pail disposal, and pneumatic tube removal, are all given place, and street cleaning is also included. The work is well illustrated and may be confidently recommended.

HANDBOOK OF CALCULATIONS FOR ENGINEERS AND FIREMEN. By N. Hawkins, M.E. Theodore Audel & Co. New York. No date. Pp. 330. Price $2.

This work is devoted to arithmetical and algebraical calculations, tables, rules, formulæ, etc., adapted to be of service to the practical engineer and fireman. It is illustrated and represents a very creditable collection of engineering information.

SCIENCE OF EVERYDAY LIFE. By John A. Bower. Cassell & Co. London, New York, etc. 1889. Pp. 128. Price 50 cents.

Matter, weight, the earth's envelope, air, combustion, and other general topics of science are here treated in popular form, with simple illustrative experiments where required. The little book is designed for children to a certain extent, but it may, we are confident, be advantageously perused by children of a larger growth.

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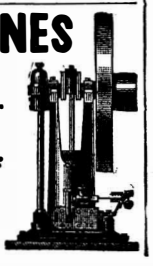

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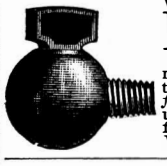

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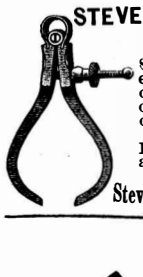

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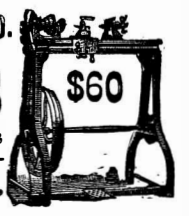

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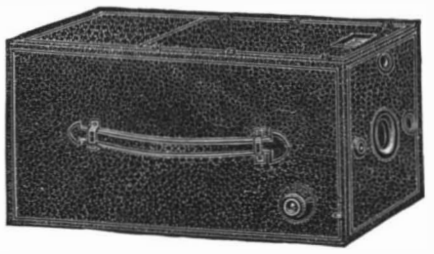

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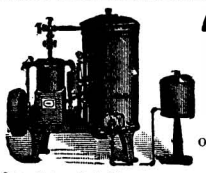

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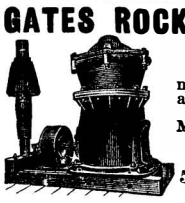

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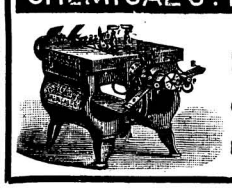

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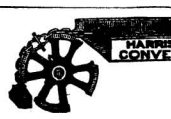

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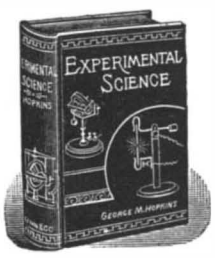

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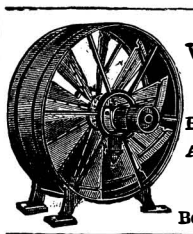

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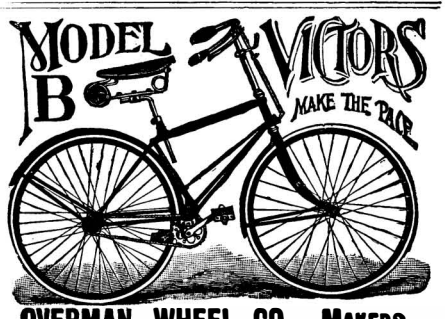

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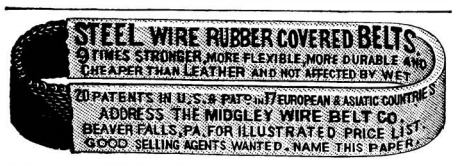
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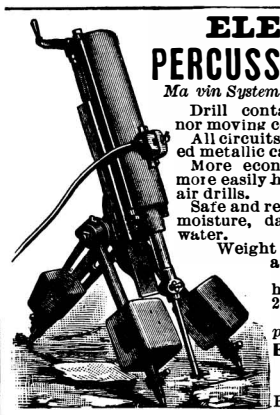

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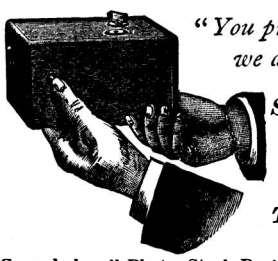

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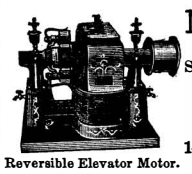

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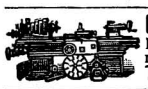

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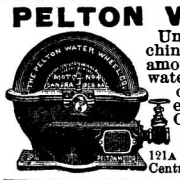

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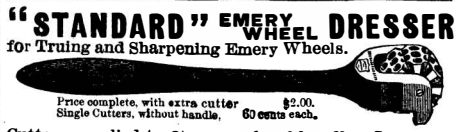

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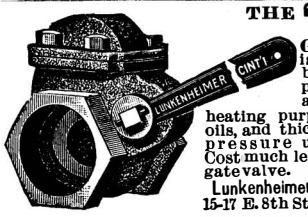

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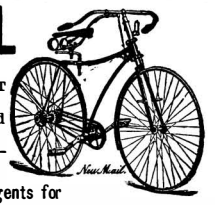

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